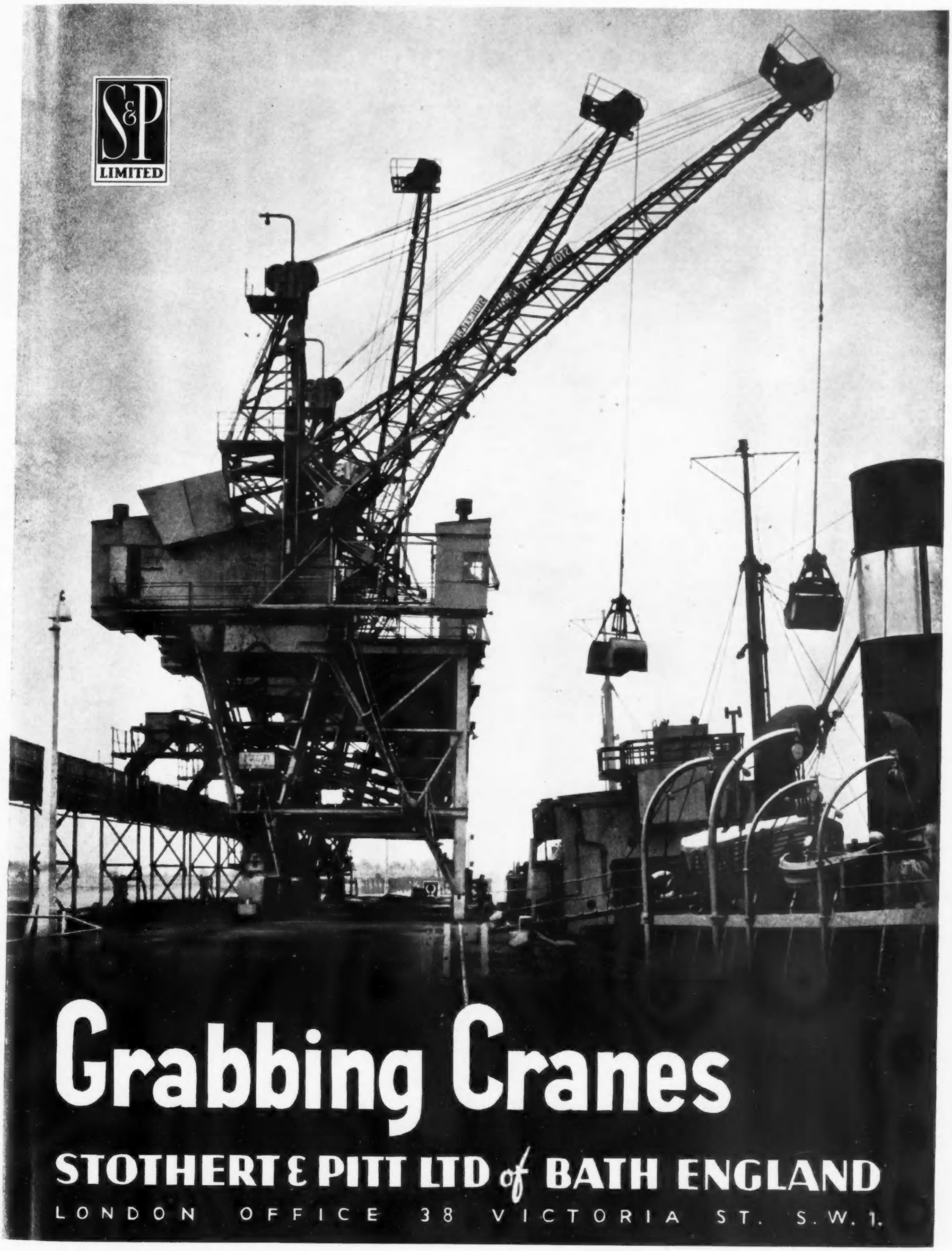
The Dock & Harbour Authority

No. 406. Vol. XXXV. AUGUST, 1954 Monthly 2s. 0d.

A RapieR 8 Super Mobile with patented cargo handling jib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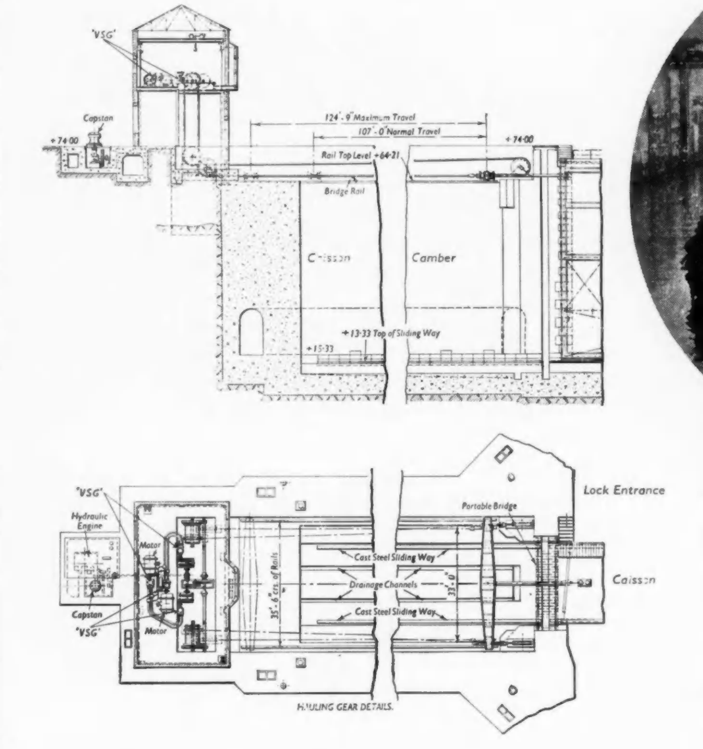
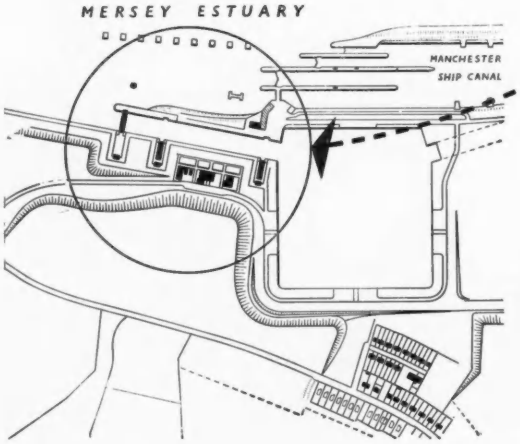


CAISSON MACHINERY LAYOUT

Uprighting Caisson Gate at entrance wall of the Manchester Ship Canal Company's new Oil Dock at Eastham.



QUEEN ELIZABETH II DOCK

Three Vickers - Armstrongs sliding caissons form an essential part of the Manchester Ship Canal Company's new Oil Dock at Eastham on the Mersey Estuary. They are part of an entrance lock into the main dock. Their all-welded steel construction displaces some 1,700 tons. Each is 106 feet long, 23 feet wide and 60 feet deep. There will be a total water pressure on a caisson of approximately 5,000 tons when water is up to the top deck on one side and it is dry on the other.

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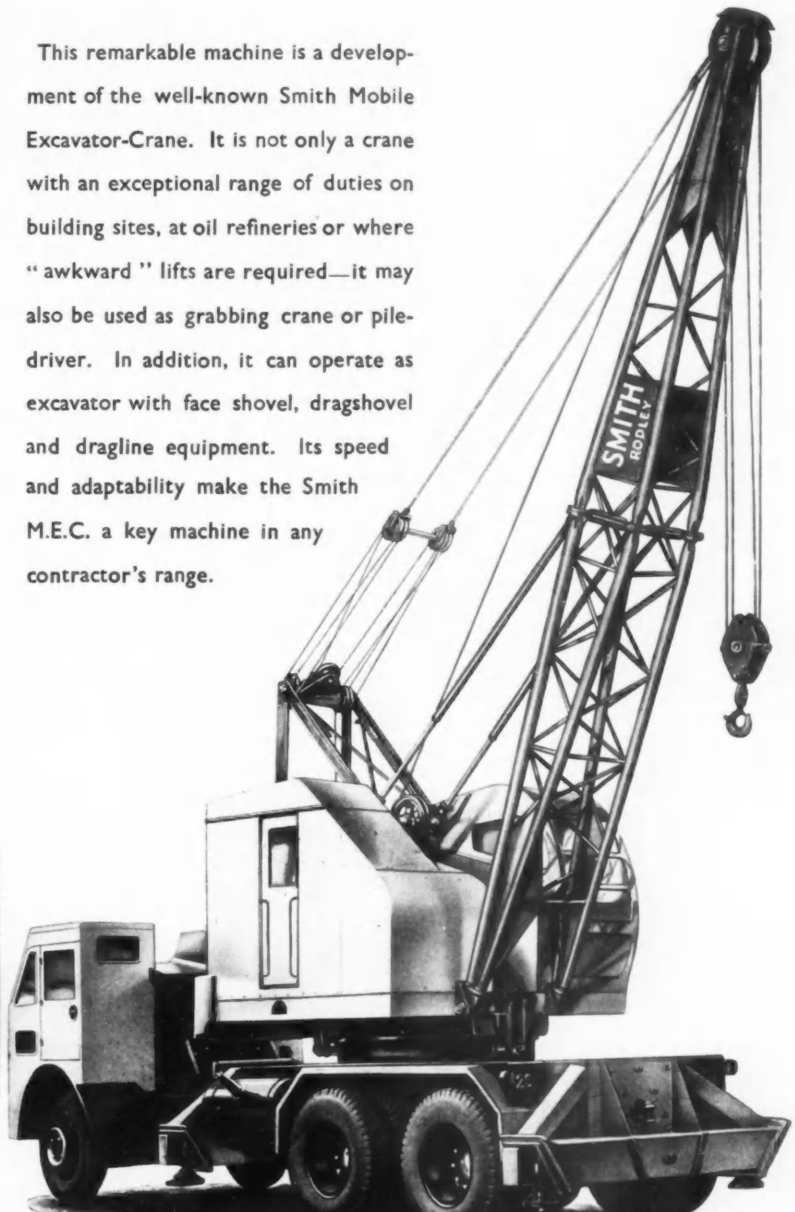
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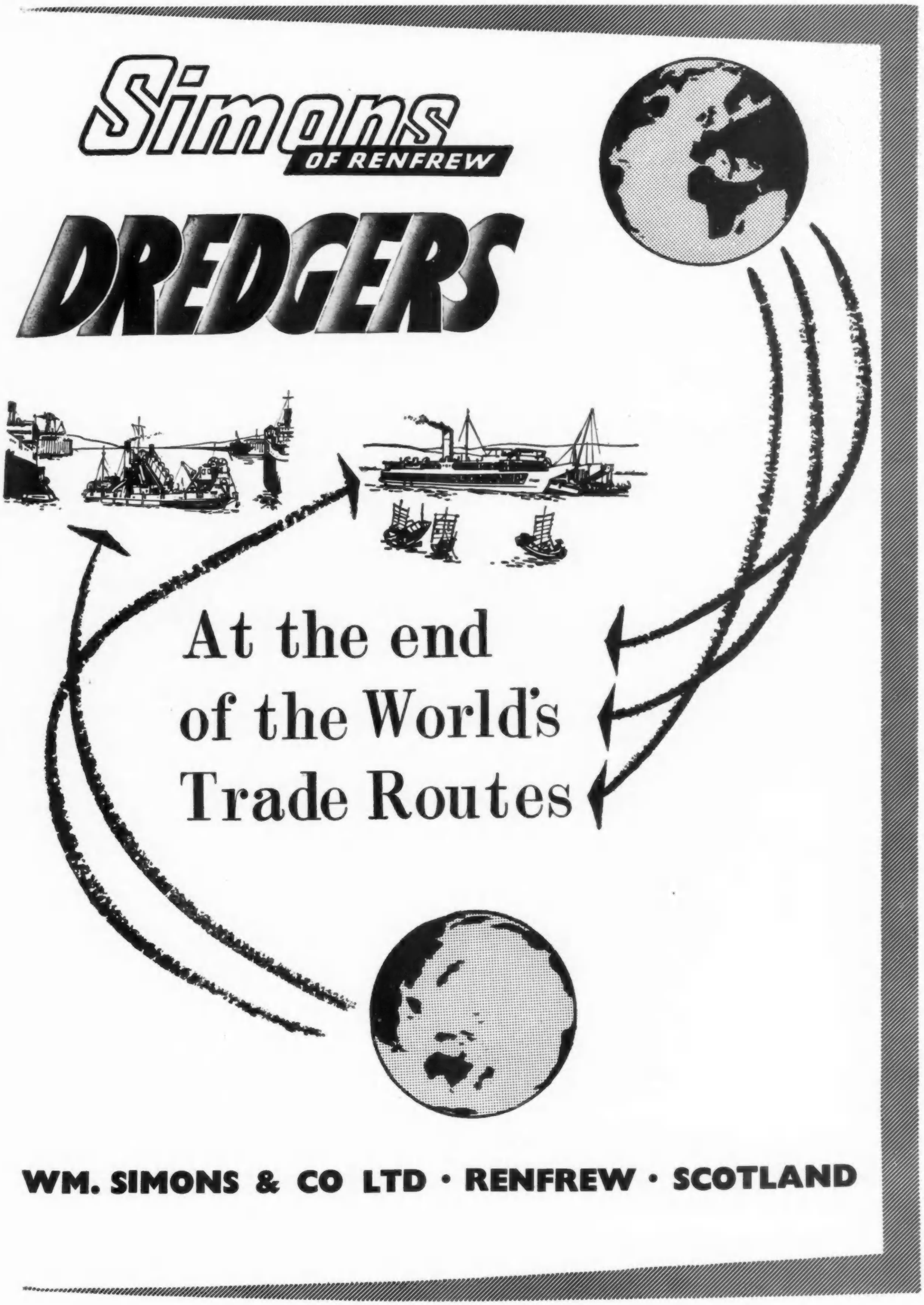
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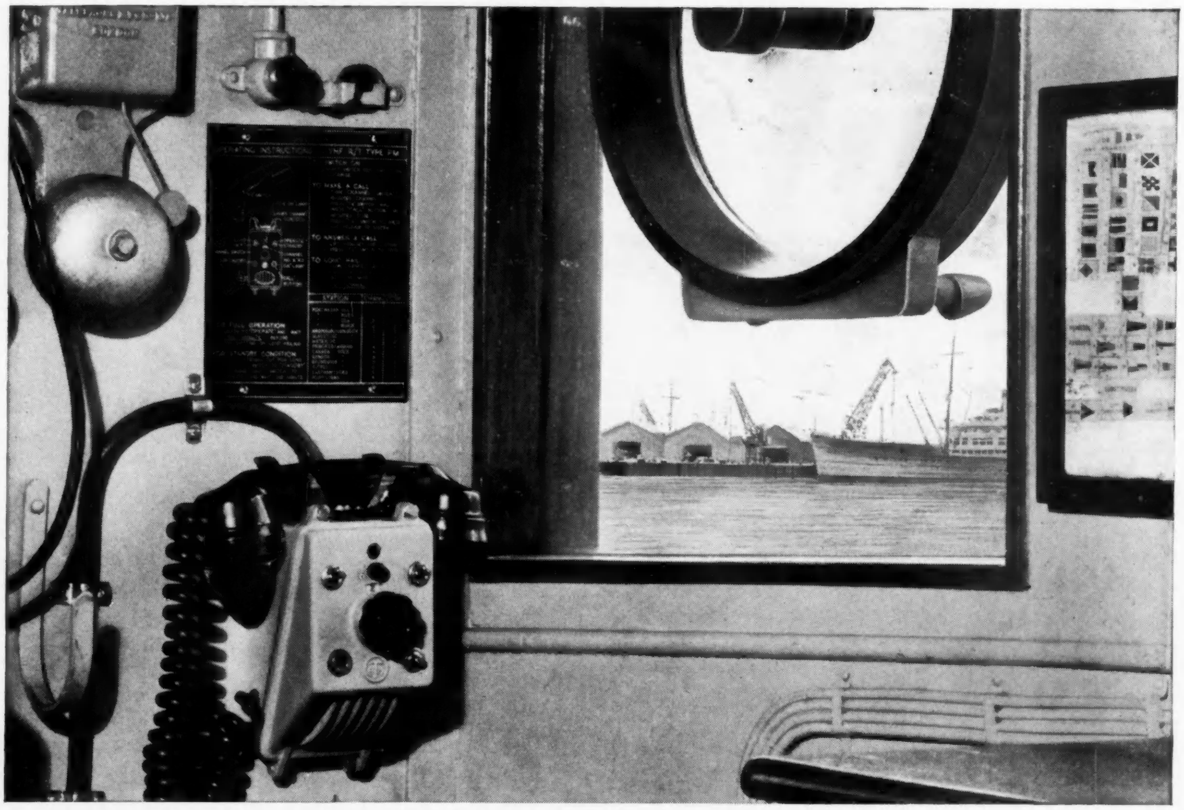
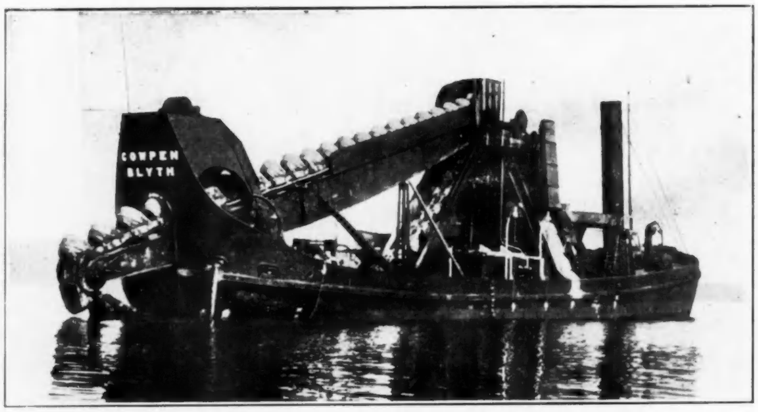
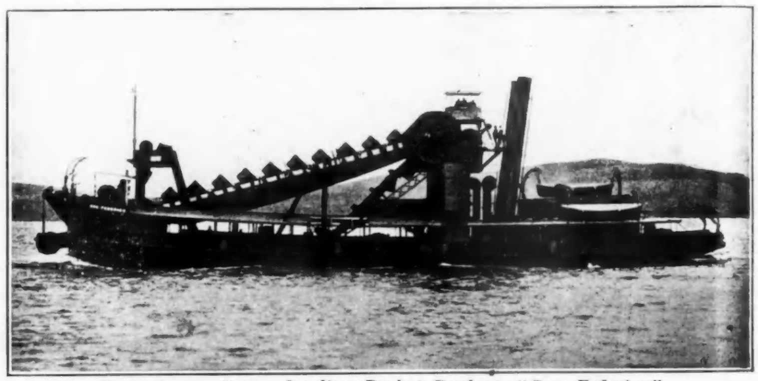


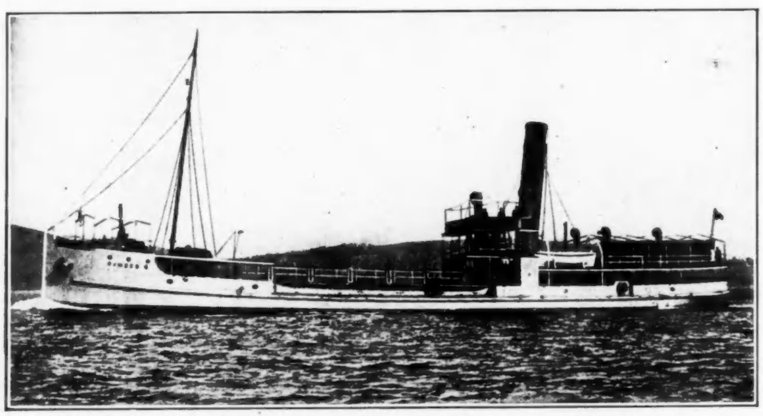
VHF EQUIPMENT ON THE 'SALVOR'—MERSEY DOCKS AND HARBOUR BOARD SALVAGE VESSEL



Twin Screw Stern-Well Bucket Hopper Dredger, "Cowpen."



Twin Screw Barge Loading Bucket Dredger, "Don Federico."



Twin Screw Suction Pump Discharge Hoppers Nos. 4 and 5.

The Dock & Harbour Authority

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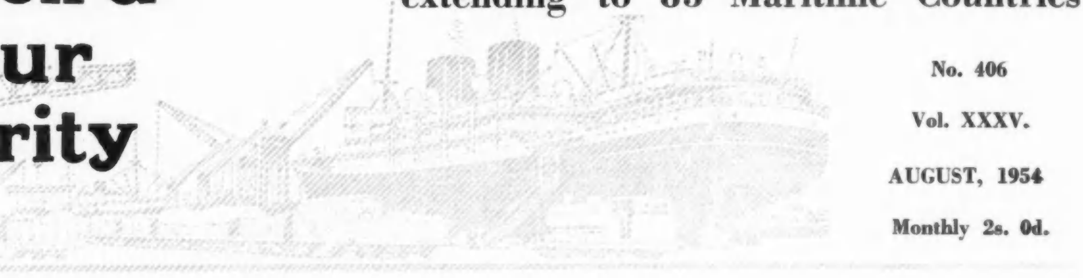


No. 406

Vol. XXXV.

AUGUST, 1954

Monthly 2s. 0d.

Editorial Comments

The Humber Ports.

The group of ports on the River Humber, administered by the British Transport Commission, comprise Hull, Grimsby, Immingham, and Goole. They serve an extensive hinterland, embracing an elaborate system of inland waterways including the Calder Canal and the River Trent Navigation. These waterways, which were described in detail in our issue for April last, carry an appreciable tonnage of goods each year, and connect directly with the Humber, acting as feeders to industrial areas many miles inland.

Since the British Transport Commission formed the Humber Ports group in January, 1949, considerable progress has been made, and during the last five years over £6 million has been spent on improvements and rehabilitation works. It also is of interest to note that the volume of traffic dealt with has shown considerable improvement during the same period. Since 1948, the tonnage of goods handled has increased by 47 per cent. (13,006,713 tons against 19,131,219 in 1953). The shipping tonnage dealt with shows a similar upward trend (8,414,169 n.r.t. in 1948 compared with 12,309,889 n.r.t. in 1953). The financial position has also improved, and a working deficit of nearly £$\frac{3}{4}$ million has been steadily reduced until in 1952 a surplus of £366,209 was realised. The figures for 1953 show a surplus of £561,128.

On a following page will be found the first of a series of seven articles reviewing the latest developments on the Humber. The introductory article gives an account of the overall activities and the reorganisation involved, since the ports were nationalised under the Transport Act, 1947. The three following articles will deal in turn with the commercial, geographical and historical aspects of each port. The remaining articles will be devoted to a description of the engineering works that have been carried out, following the severe damage inflicted during the Second World War. They also will give details of the present equipment and cargo-handling facilities, and finally, will survey future plans and development schemes for the whole area.

The increasing prosperity of the ports under the new regime is encouraging, and the Docks and Inland Waterways Management who are responsible, under the B.T.C., for carrying out the re-organisation schemes, are to be congratulated on the success which has been achieved since the four ports were combined under one authority.

Women Police for Docks.

One generally thinks of the dock industry in terms of dockers, stevedores, lightermen, tally clerks and so on—titles which are in this country essentially male.

The number of women employed within the customs fences of the five dock areas of the Port of London Authority has, however, increased steadily throughout the years—the innovation of dock canteens with their attendant cooks and serving staff, the increasing employment of women in dock offices and tenants premises and particularly in the milling industry—has led the Port Authority to augment their Police Force with a small section of women police.

At the outset six women have been engaged and will start training this month at the Authority's own training school at the Royal Albert Dock. For a period of not less than three months the new recruits will carry out normal training routine duties including such work as life-saving, first-aid and civil defence. From the Training School they will be posted to the P.L.A. Police H.Q. at the West India Docks for Criminal Investigation and uniform duties and to the Police Information Room at the Royal Docks.

This innovation follows that of H.M. Customs and Excise Service which in 1948, with the aim of achieving higher efficiency, approved the employment of a number of women officers for searching duties among women passengers and the female personnel of ships' crews.

There is no doubt that the introduction of women police into the Authority's Force will prove beneficial.

The New Shipbuilding Dock at Newport.

We are publishing in this issue a description of a dry dock which was recently completed at Newport. The new dock is of somewhat novel construction, the principle adopted being the use of steel sheet piling for the side and end walls.

While unusual, the form of construction is not unique, a much larger example of its kind being the original Wartier Lock in the Port of Dunkirk, which was built many years before the recent World War, during which it was destroyed by enemy action.

The Newport Dock is eminently suited to the purpose for which it is intended—the building of pre-fabricated ships of small size. Indeed, the whole undertaking is a good example of economic construction, and the celerity with which the work was carried out is remarkable. The dry dock, now completed, is to be followed by two others that are projected for building vessels of 40,000 tons.

This new shipyard has made history in that it is the only one built in the United Kingdom during the past thirty years, and the first yard, in this country, which will launch ships by floating them out of a dry dock instead of down a greased slipway, a method which presents certain dangers and difficulties. The new method also appears to have the considerable advantage that if the dock is not required for ship building it can be used for ship repairs.

The revolutionary shipbuilding technique of welding instead of riveting will also be practised. This necessitates pre-fabrication methods of assembly, which must be done under cover, and has been arranged for by the construction of production and assembly shops, and the provision of movable shelters over the dry dock.

Steel for shipbuilding will come from rolling mills in South Wales, and local labour specially trained for the purpose, will be employed.

At this time of increasing foreign competition, it is essential that the country's costs of production should be reduced wherever possible; this applies particularly to the shipbuilding industry, if Great Britain is to maintain her place among the world's greatest shipbuilders. The inception and execution of this shipyard is an encouraging example of enterprise and co-operation to that end.

Fire Prevention.

The destruction by fire of the troopship "Empire Windrush" in the Mediterranean last March, and of the Norwegian freighter "Mildrid" off the entrance to Harwick harbour early this month, again draws attention to the hazards of fire and the need for preventive measures.

Editorial Comments—continued

The importance of fire prevention and fire fighting in ports has frequently been referred to in these columns, and in this issue we are now publishing a further article which briefly reviews recent British research into the causes and prevention of fires, both ashore and afloat.

The necessity for complete collaboration between all concerned in minimising the fire risks of ships in port needs no emphasis, and as our contributor suggests in his article, the formation of fire-guards to this end deserves some earnest consideration. Such a working organisation with frequent fire-drills would, we feel, serve a very useful purpose and would stimulate and keep alive "fire-consciousness" among employees on the dockside.

Beacons as Navigational Aids.

Little technical information appears to have been published on the subject of beacons, lights and channel demarcation generally. We have therefore arranged to publish in this and the two following issues a comprehensive article which will provide our readers with a reliable guide to current general practice in this important aspect of navigation.

A clear and systematic demarcation of the channels by which a port is approached from the open sea is an essential duty of a lighting authority. Uniformity of practice throughout navigable waters and harbour approaches is obviously desirable, but until comparatively recent times the marking and lighting of approach channels to ports was regarded as only of national concern. However, international uniformity has now been largely achieved, and our contributor traces the events and conferences which have given rise to the system now in use.

Readers, who will find much of interest in the present contribution, are also referred to a previous article entitled "Ships that serve ships—a history of Trinity House," which appeared in the February 1952 issue of this Journal.

Proposed Port Improvements in El Salvador.

The Republic of El Salvador has recently been engaged on a comprehensive study of its port facilities with the assistance of United Nations advisers and a United States engineering organisation. Proposals for improvements to the Salvador ports of Acajutla, La Libertad, and La Union are now being reviewed by the Comision Ejecutiva del Puerto de Acajutla (the Commission which is responsible for national port development), and a decision regarding future reconstruction and extensions is expected in the next few months.

El Salvador's coast line lies entirely on the Pacific side of the Central American Isthmus. Two of the ports—Acajutla and La Libertad—consist only of open roadstead anchorages and lighterage piers, without shelter or protection from the weather. The piers were completed in 1900 and 1870 respectively, and, although reconstruction and repair work has been undertaken from time to time, both piers are now in an advanced state of dilapidation. The third port—La Union—lies in a sheltered estuary in the Gulf of Fonseca, and ships are well protected from the Pacific swell. The port is handicapped, however, by an entrance channel with only 23 feet depth of water at low tide; a silt bar across the entrance restricts the entry of ocean-going ships to high tide only. Two alongside berths are available at Cutuco Wharf, a reinforced concrete wharf structure completed in 1914.

Port operation is carried out by the privately owned inland transportation agencies—The International Railroad of Central America, The Salvador Railway Company, and the Agencia Salvadorena (a road transport and stevedoring company). There is at present considerable congestion in the customs warehouses, and importers often experience delays of several weeks in obtaining delivery of cargo.

The shipping lines serving this part of Central America rely mostly on the smaller type of coastal cargo carriers. Since cargo consigned to San Salvador City (the commercial and business centre of the country) may be routed through any of the three ports, in accordance with the wishes of the consignor, ships may be required to call at each port with small cargo consignments of less than 100 tons. In consequence, much time is wasted in entering and clearing the ports, and a quick turn-around is hard to achieve.

The economy of El Salvador is based on its coffee crop; 75 per cent. of its exports consist of coffee—a mild variety which commands a high price on the world market. Imports, consisting of general cargo and petroleum products, amounted to 300,000 metric tons in 1952, with a value of 70,000,000 U.S. dollars. The favourable trade balance was 20,000,000 U.S. dollars.

The present boom in world coffee prices, and the programme of modernisation and industrialisation which is now being actively pursued by the Government, appear to be a combination of circumstances highly favourable to an expansion of international trade in the immediate future. Ship owners and merchants will welcome the provision of adequate deep water port facilities.

Topical Notes

Port of Richborough Reopened.

One of England's oldest ports, Richborough in Kent, has been revived and was officially opened to traffic early this month.

Richborough was the site of the landing of the Romans in 55 B.C. and for centuries it remained disused until it was revived both in the first and second World Wars for military and naval uses. Now it takes a new lease of life as a civil port operated by Richborough Estates.

It is claimed that, after dredging and other improvements have been carried out, the port will be capable of accommodating ships of up to 2,000 tons. At present ships of 600 tons can enter. Plans are afoot for the development of a ferry service for cars, railway trucks and lorries, making use of existing end loading berths and of some of the materials of a former train-ferry dock which are still in existence. A dry dock and ship-breaking facilities are also planned as is the provision of an underwater pipeline for handling liquid cargoes to and from ships too large to enter the port.

Rail communications have been restored, and the owners have control of about 200 acres of land in addition to the port itself, on which it is hoped to establish industrial and other buildings.

Contract for Gold Coast Harbour.

It was announced in London early this month that the Government of the Gold Coast has awarded the contract for the construction of a harbour at Tema, 17 miles east of Accra, jointly to John Howard & Co., Ltd., and Sir Lindsay Parkinson & Co., Ltd. The contract is stated to be worth £7,521,804, and work is expected to start towards the end of this year and to be completed four or five years later.

The work includes the building of two breakwaters of about one mile and one and a half miles in length; these will enclose an area of over 500 acres of water. A finger quay to accommodate four ships, a fishing harbour, warehouses, railway marshalling yards and a station are also to be built.

This will be the largest entirely artificial harbour in Africa, and a more detailed outline of the proposed construction works was given in this Journal in the issue for February last. The consulting engineers are Sir Wm. Halcrow & Partners.

New Traffic to U.S.A.

At No. 7 Shed, King George V Docks, the Cunard Line vessel "Andria" which sailed for New York at the end of last month, was fitted with two 3,000 gallon capacity tanks, welded on deck, for the carriage of Cresylic Acid in bulk. The liquid was pumped direct from specially fitted road tank vehicles belonging to the manufacturers of the Cresylic Acid.

Shipment previously was in drums, but the new method is considered to have many advantages, not only by the quick transfer to or from the ship but also the lessening of the risk of loss or contamination to other cargo. Flexible steel tubes were connected from vehicle to the tanks on board, and at the completion of pumping the surplus liquid in the pipes was drawn back to the road vehicle. During the whole operation there was an absence of odour or escape of liquid.

The Humber Ports

(1) General Introduction to the Series

(Specially Contributed)

ALTHOUGH the River Humber is only a little over forty miles long, its tributaries extend from the neighbourhood of Birmingham to the North Riding, and drain an area which includes about a quarter of the land surface of England. On the estuary itself lie the ports of Hull and Grimsby and Immingham, but Goole, while within the administration of the Humber Ports Group, is in fact on the Yorkshire Ouse in the West Riding, some fifty miles from the sea. From small beginnings these ports have grown steadily over the years, and they are now of vital importance to the maritime trade of the great industrial areas of the North Midlands and West Riding of Yorkshire.

Their history has been marked by vicissitudes, and in recent years development has been largely in the importation of foodstuffs, of raw materials for industries, in the landing and marketing of fish and in the shipment of coal. During the war all the ports suffered from the cessation of trade with the Continent and the transfer of shipping business to the West Coast, while Hull in particular was heavily damaged by enemy action, and lost not only its Riverside Quay but many other berths, and much of its covered transit and warehouse accommodation.

Since the war there has been a progressive increase in trade, and a great deal has been done in the way of repair and rehabilitation to bring the berths and other facilities up to modern standards. Much still remains to be done, but nevertheless the net registered tonnage of shipping entering the river reached a record high level in 1953. There are hopes that the figure may be raised still further, and in this and succeeding articles it will be the intention to give a brief description of the trade of the ports and the engineering works undertaken towards future development.

Organisation:

As a consequence of the Transport Act 1947, under which were set up the British Transport Commission and its Executives the Humber Ports group was formed in January, 1949, and placed under the control of the Chief Docks Manager, Humber Ports. Although all the ports were Railway owned immediately prior to Nationalisation, with the exception of the Aire and Calder Navigation Co.'s interests at Goole, the management had previously been exercised from York in respect of Hull; from Euston and Leeds in the case of Goole and from Liverpool Street for Grimsby and Immingham. Thus there were administrative as well as operating problems to be faced, and for a Headquarters use was obtained of the former Hull Dock Company's premises in Hull.

The Dock Office, occupying a conspicuous island site in the centre of the City and Port of Kingston-upon-Hull, is a well-known landmark occupying about a quarter of an acre of ground. Carried out in Ancaster Stone, the building was erected in 1871 at a cost of £90,000 by the Hull Dock Company, the then owners of the Hull Docks who, in 1778, had opened the Queens Dock, the first to be constructed in the port. The site of the Dock Office was adjacent to the Queens Dock which, after more than 150 years of useful service, was filled in and transformed into the Queens Gardens.

The building, designed by Mr. G. C. Wray, the London Architect, is of Italian Venetian style, and there are three facades, two straight and one bowed, corresponding with the frontages. At the three angles stand circular towers of the composite order surmounted by domes lead covered and crowned with lanterns, which bring the total height to 100-ft. The architectural treatment of the ground floor is Ionic, and that of the first floor Corinthian. The panels over the windows and spandrils of the arches are richly carved; a deep and highly ornate cornice with medallion windows in the frieze surmounts this order, and there is a double-blocking course over it. The main entrance of the Dock Office is in Queen Victoria Square, and has a portico on the ground floor with projecting pilasters and engaged columns on the first floor. Above the main cornice is a pediment, the tympanum of which is enriched with a sculptural representation of Commerce, Prosperity and the River Humber, and over this is grouped a trophy of the Arms of the Hull Dock Company, of the City of Hull and of the Trinity House. The entrance at the rear of the building in Queens Dock Avenue is crowned in the centre with another trophy representing Neptune and Amphitrite supporting the Arms of the Dock Company.

Headquarters, Humber Ports, front view of the Dock Office, Victoria Square, Hull.

Internally, a feature of the Dock Office is the entrance hall with its spacious staircase. Until World War II three large elaborately chased windows bearing the Arms of the Dock Company extended from the first landing to the ceiling, but they were shattered during the hostilities. Perhaps the finest apartment of the building is the Court Room, on the first floor, and overlooking the Queens Gardens. Seventy feet long, 29-ft. wide and 21½-ft. high, the room has an elaborately decorated ceiling supported on each side by 16-ft. high red marble columns with ornamental capitals. Between the columns is a sub-order in the composite style, over the entablatures of which are placed figures holding shields

The Humber Ports—continued

Berthing of M.V. "Gothic" at King George Dock, Hull.

bearing the Arms of various ports trading with Hull. To-day it serves as a Drawing Office for the Engineer's Department.

For over 20 years the management and staff of the Hull Dock Company occupied the Dock Office. The Chairman and Directors of the Company frequently banqueted in the Court Room adjacent to which, at the North end, were kitchens and serving rooms. It was in this room that King Edward VII, as Prince of Wales, on the occasion of one of his visits to Hull attended a banquet. When the North Eastern Railway acquired the Dock Company's undertaking in 1893, the Dock Office continued to serve its original purpose, providing office accommodation for the Railway and Dock Officers and staff. To-day it is the property of the British Transport Commission, and the Docks and Inland Waterways Headquarters of the Chief Docks Manager for the Humber Ports of Hull, Immingham, Grimsby and Goole.

At these offices are accommodated the Chief Docks Manager and Civil Engineer with their establishments, the traffic management being decentralised through Dock Managers at Hull and Goole, and the Port Master at Grimsby in charge of Grimsby and Immingham. Also with Headquarters in Hull are the Mechanical and Electrical Engineer, the Accountant and the Estate Surveyor with, in each instance, subordinate Officers at the other ports as necessary. Altogether the Dock Authority have a staff of nearly 6,000 on operating and maintenance work, while the dockers' registers under the Hull and Goole and the Grimsby and Immingham schemes of the National Dock Labour Board total just over 6,000.

It is perhaps of interest to note that while the Dock Authority own the docks and control their working, the River Humber is the responsibility of the Humber Conservancy Board, a public Authority formed in 1907 as successors to the Conservancy Commissioners and other bodies charged with various functions. The Conservancy Board is also the Pilotage Authority.

Traffic:

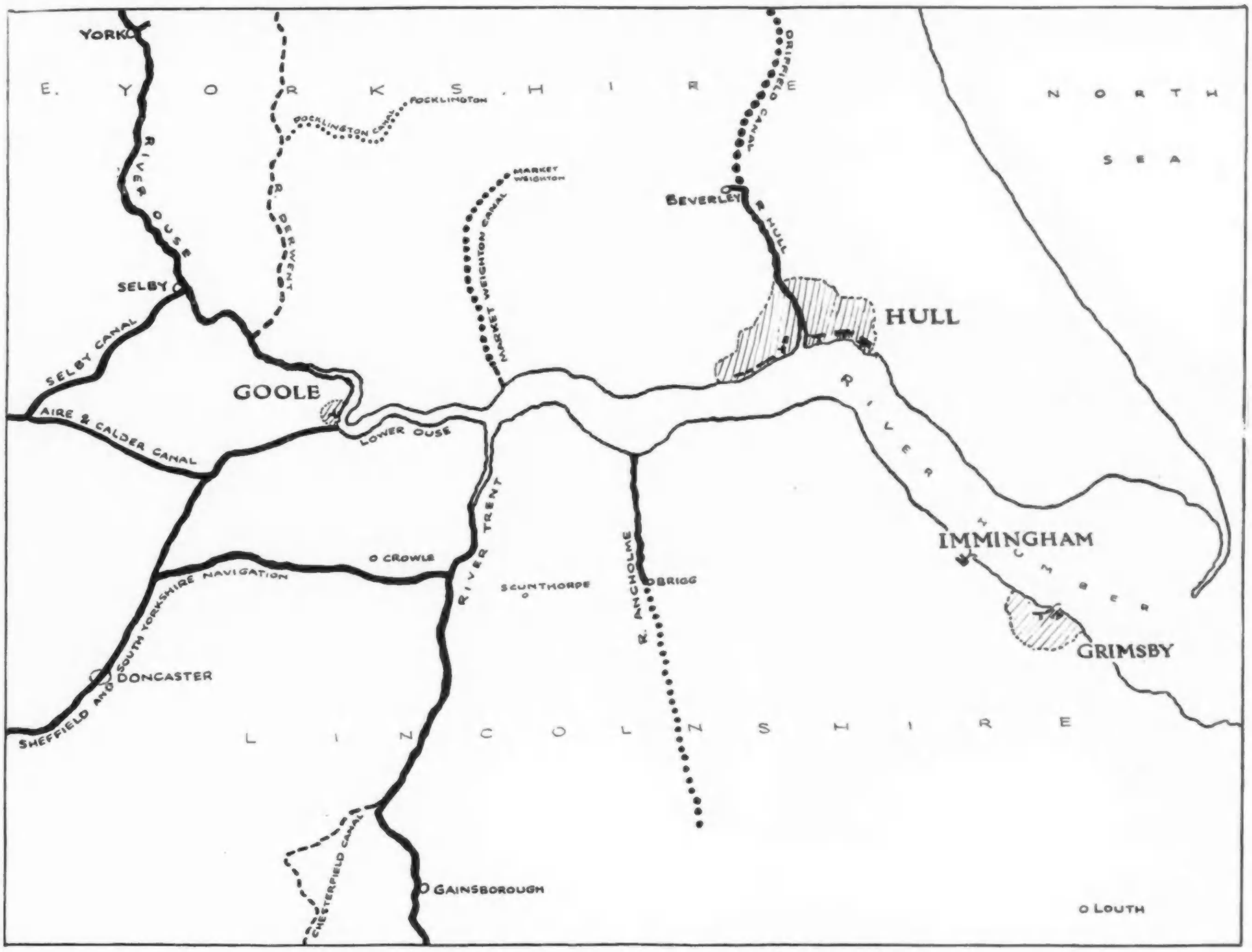
The heaviest tonnages passing through the Humber Ports are the imports of raw materials and the shipment of coal and coke. In 1953 more than 19 million tons of traffic were dealt with through the four ports, while the total net registered tonnage of shipping entering the Humber exceeded 12 millions.

In terms of tonnage, the principal inward traffic is bulk oil and spirit, mainly received at the Salt End Jetties, which lie at the seaward end of the Hull Docks estate. Over 1½ million tons are pumped annually through the Salt End pipe lines whilst within the last five years the Eastern Jetty at Immingham has also been converted to a bulk oil terminal. The extensive canal and waterways connections of the Humber form an attractive means of transport for the delivery of this class of traffic to inland wharves, and tank barges in capacity ranging from 150 to 300 tons each, operated by lighter owning Companies, carry inland each year upwards of 400,000 tons of oil and spirit from Hull, and 150,000 tons from Immingham. In addition to this inland waterways traffic, there is a distribution of oil and spirit each year by coastwise vessels from Hull of 250,000 tons, and from Immingham of 30,000 tons.

Imported ores are handled to the extent of threequarters of a million tons a year, principally through Immingham. Over half is iron ore for the Sheffield and Scunthorpe steel making plants. In addition, half a million tons annually of material such as iron and steel ingots, crude nickel, copper, aluminium and zinc is imported mainly through Hull for allied industries. The rapidly increasing use of chemical fertilisers is reflected in the import of phosphates, potash and other base chemicals which are now a major traffic through the Humber, and at

General view of King George Dock, Hull, containing vessels representing 78,000 G.R.T.

The Humber Ports—continued



The Humber Estuary, its docks and inland waterways connections.

Immingham extensive premises for the manufacture of fertilisers have been built on the dock estate with a conveyor system for the direct transfer of raw materials from the quayside to the factory plant.

Much attention has been focussed on timber supplies for house building in Britain since the war, and subsequent relaxations in the control of sawnwood have led to considerably heavier arrivals from Scandinavia, which is the traditional home of the first-class joinery woods used in this country. Hull, Grimsby and Immingham are well equipped to deal with sawnwood, and have storage space capable of absorbing peak arrivals during the timber season. As the Humber also serves important mining districts the annual tonnage of pitwood imported is heavy, and this traffic too calls for shipping berths where handling is unhampered by other dock operations, and storage yards where preparation can be undertaken prior to despatch to the collieries. Attention has been given to these considerations in recent years, and the total area available for the storage of sawnwood and pitwood at the Humber Ports is now over 200 acres. In all approaching 900,000 tons of timber are handled each year.

Besides the heavy commodities there are the ranges of articles which are highly valuable in relation to weight, and amongst these raw wool is particularly prominent. An impressive proportion of the total tonnage of this material destined for the West Riding woollen industries was handled at the Humber Ports in 1953, when, in fact, one-third of the wool landed in the United Kingdom came through Hull. Direct shipments of wool from Australia and New Zealand to Hull have been increasing since the war, but in addition there are considerable quantities of wool which are transhipped at London and brought up to Goole by coastwise vessels.

Australian and New Zealand vessels sailing direct into the Humber Ports bring also frozen meat, fruit and a great variety of canned foodstuffs. The total import of such commodities from all countries is in the order of threequarters of a million tons a year. All types of grain and milling offals are also a feature of Humberside trade, and grain berths are available with two silos, one of which is of 40,000 tons capacity. Reconstruction by established warehouse-keepers of accommodation lost at Hull during the war, in many instances incorporating improved facilities, enables normal stocks again to be stored at or near the docks.

Re-organisation in the industry has led to some diminution in recent years of imported oilseeds and nuts for crushing, but, even so, a third of a million tons were handled in 1953. A feature of dock working at Hull is overside handling, principally from import vessel to dock lighter or river craft, and this method is usually employed for bulk oil-seeds and similar traffics. In addition to foodstuffs from far distant countries, there is a regular business at Hull, Grimsby and Goole in the imports of Scandinavian provisions—butter, eggs, bacon and fats, as well as fondants for the wholesale confectionery trades, and in soft fruit and vegetables in their seasons from the Netherlands and France. The earliest trade of the Humber was with Europe, and to-day traffic to and from Continental ports is extensive. Such services comprise twenty-nine weekly and seven fortnightly sailings, and link Hull with Norway, Sweden, Finland, Denmark, Poland, Germany, France, Holland and Belgium; Grimsby with Norway, Denmark and France; and Goole with Denmark, Germany, Holland, Belgium and France. These regular sailings are frequently strengthened

The Humber Ports—continued

to meet peak demands.

Coal and coke is by far the largest export from the Humber Ports, and total shipments in 1953 reached the post war record of 10,000,000 tons. Of this figure, 3,600,000 tons represented exports to foreign markets and 5,500,000 tons for coastwise destinations, whilst 900,000 tons were taken as bunkers by vessels using the ports. Trawler bunkers at Hull and Grimsby accounted for 600,000 tons of the latter figure. Hull and Goole shipped about 5,000,000 tons of coal from the North-Eastern Division of the National Coal Board, and about 500,000 tons from the East Midlands Division, whilst Immingham and Grimsby shipments comprised 4,500,000 tons from the East Midlands Division and comparatively little from the North Eastern Division. The National Coal Board intend to produce more coal from the West Riding and North Midlands areas, and it is understood that future expansion is likely to be eastwards from the present coalfields. Coal shipment from the Humber may, therefore, be expected to be in increasing quantities in the years to come. Most of the coal for shipment is railborne, but at Goole there are facilities for the expeditious handling of canal-borne coal, more than 800,000 tons being so dealt with in 1953. The movement of great tonnages of coal from coalfields to the ports of shipment is a story in itself, and calls for close liaison between the traffic controls of the transport organisations, the dock owners and shipping authorities.

Although the tonnage of coal and coke shipments predominates over all other exports through the Humber, the latter are by no means insignificant, particularly to the ports of Northern Europe. Large quantities of machinery are shipped, and in recent years these have included electric generating plant and forging presses involving lifts of up to 100 tons. Nowadays many of these "heavy lifts" arrive on specially designed road vehicles, and post-war development programmes at the docks have included a widening and strengthening of roadways and improved access to heavy crane berths. The Humber Ports are also shipping their share of the lighter mechanical goods in which special efforts are being made to increase exports. There is a constant stream of new motor cars through Hull and Immingham to various parts of the world, especially to the Continents of America and Europe. Thousands of new agricultural tractors have been shipped to Scandinavia and other North European countries in recent years.

In addition to the ordinary commercial traffics dealt with at the Humber Ports, there are the important fishing interests at Hull and Grimsby which land between 400,000 and 500,000 tons of fish per annum. Five enclosed docks, with a total water area of eighty-three acres, are entirely devoted to the fishing industries which operate a fleet of nearly 500 trawlers consisting for the most part of modern vessels, some of which are 180-ft. in length. Hull and Grimsby together handle more than half the total quantity of fish brought into the United Kingdom.

This resumé of the nature of trade relative to the Humber Ports will be expanded in succeeding articles commenting upon the individual ports in the group.

The Port of Mtwara

Deep Water Harbour for Southern Province of Tanganyika

The Port of Mtwara was officially opened by the Governor of Tanganyika, Sir Edward Twining, on the 17th July last. Also attending the opening ceremony were Major-General W. D. A. Williams, Commissioner of Transport, Mr. A. F. Kirby, general manager of the East African Railways and Harbours Administration, Sir Andrew McTaggart, managing director of Balfour, Beatty and Co., Ltd., and Mr. R. D. Gwyther, of Coode and Partners, consulting engineers.

In his opening address, the Governor referred to the great financial help the British Government had given and mentioned that the cost of constructing the port and railway had greatly exceeded the estimate. The revised total was now £6½ million, and Her Majesty's Government had agreed, subject to the approval of Parliament, to forego the repayment of about £3.7 million capital and the interest thereon so as to reduce the capital investment to a reasonable figure, estimated at about £2¼ million. The East African Railways and Harbours Administration will forego the fixed annual renewal charges, about £95,000 a year, for so long as deficits are experienced, while the Tanganyika Government has agreed to assume responsibility for the whole of the net operating deficits on the re-capitalised structure.

An important consideration in connection with the development of the Port was the reduction of the rates charged by the shipping lines calling at Mtwara. The Governor expressed the hope that they would see their way to treat it as a berth port. The shipping companies concerned had a great record for taking risks in opening up backward countries. These risks had in course of time been justified, the companies had prospered and their names were now famous.

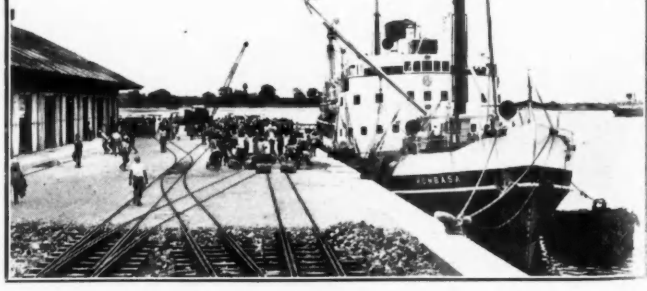
The Government had shown boldness in providing this backward part of the territory with essential means of transport to enable its natural resources to be developed. He commended to shipowners a policy of boldness now, for he was sure that later they would not regret it. Meanwhile, he was glad to say that as a first step shipping companies had agreed to reduce the rates to the same level as at the new port of Nacala in Portuguese Africa.

Commenting on the Government's faith in the future of the port and on the growing importance of the Southern Province, Sir Edward said it was estimated that in the present agricultural year production in the province would reach 75,000 tons, of which not less than 50,000 tons would be shipped through Mtwara.

Details of Construction

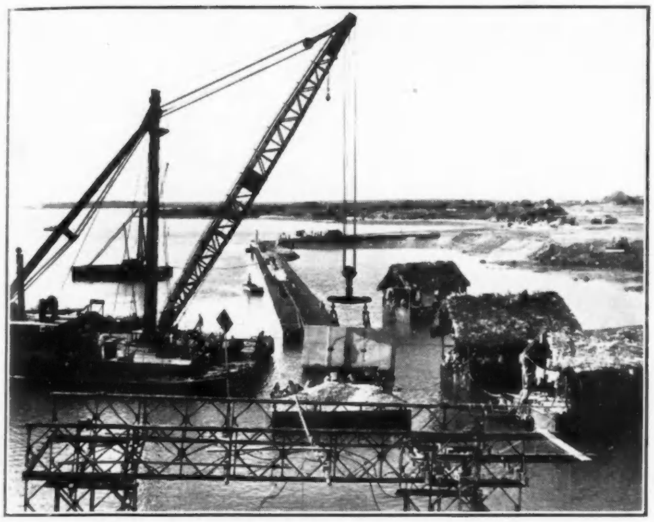
Mtwara is Tanganyika's first deepwater harbour and is situated in a deep lagoon, four and a half miles long by a mile and a half across. It was originally designed for the Overseas Food Corporation's Groundnut Scheme, and construction was begun in 1948 for the express purpose of providing a deep-water berth to export an estimated 400,000 ton annual crop of groundnuts. Mtwara was chosen as the most suitable site for a port in preference to the already existing port of Lindi—the nearest outlet to the sea from the proposed groundnut area—because the physical characteristics of Lindi precluded its economic development into a major port. Mtwara possesses a fine entrance through which ships of any draught may enter or leave at any state of the tide and it has a naturally protected anchorage which is spacious enough to accommodate a large fleet of ships, while the immediate adjacent land area is very suitable for port and rail installations and for the building of a township.

The port works were designed by Messrs. Coode and Partners, Consulting Engineers, and the contract for the work was let to



The s.s. "Mombasa" alongside in January, 1954.

The Port of Mtwara—*continued*



A 50-ton concrete block being lifted clear of the pontoons prior to being lowered into position.

Messrs. Balfour, Beatty and Company, Ltd. The completion of the port was originally scheduled for October, 1950, and by the end of 1949 some 6,000 people were engaged on the port and railway works. The method of building the quay wall, about 1,248-ft. long, is of interest in that 50-ton grooved blocks, five blocks forming one complete slice of block wall, were adopted as compared with the more usual 12 to 15-ton blocks. First a shallow trench was cut in the sea bed by means of a drag line; this trench was then filled with rubble to a depth of 5 to 7-ft. On this foundation were laid the 50-ton blocks, a total total of 1,770 blocks being used. These were made locally, lowered down a gradient and floated into position by two self-locking pontoons. They were then lowered into place by a floating crane, divers giving telephone instructions from under water to the driver of the crane. Behind the quay wall 610,000 cubic yards of filling were required to make up the transit area.

In June, 1950, forward movement of the blockwork comprising the abutment of the quay wall was a cause of anxiety, and as this movement continued in 1952, though more slowly, it was considered advisable to tie the wall back, and this remedial measure was entirely successful, and has effectively prevented any further movement.

By the end of 1953, the project was nearly completed, and on 22nd January, 1954, the first ocean-going vessel to discharge and load general cargo was berthed alongside.

Rail Communications

The port is linked to the hinterland by the Southern Province Railway, which will serve an undeveloped area—hitherto lacking in good communications—and open up the possibility of a route to Lake Nyasa and Central Africa. It is 132 miles long, from Mtwara to Nachingwea, passing through Ruo, Mtua and Mtama.

The railway was planned primarily with the object of transporting large groundnut crops from the Nachingwea and further areas to the Port of Mtwara. After the failure of the original scheme, a Tripartite Agreement was entered into by the Overseas Food Corporation, the Tanganyika Government and the East African Railways and Harbours Administration to provide the finances for the completion of the port and railway, as it was considered that the potentialities of the Southern Province warranted this expenditure.

The earthwork in the building of the railway was at first done by hand, but mechanical equipment was brought into use by the end of 1948. By that time about 27,000,000 cubic feet of earthwork had been completed over about 60 miles of the route and the track had been laid in Mkwaya yard and for six miles towards Ruo. The completed line from Mkwaya to Nachingwea—81 miles in length—was opened for traffic on 25th October, 1949.

The contract for the Mtwara/Ruo link was let to Messrs. Paulling and Company in 1948, but the work was taken over departmentally by the East African Railways and Harbours Administration in 1950. Work on the Ruo/Mtwara section was difficult. Many bridges, including a 100-ft. span at Mikindani, had to be constructed and cuttings and embankments in unstable soil were very troublesome and costly. The work was also delayed by a cyclone in April, 1952, when the heavy rain severely damaged the newly made foundation. The last length of rail was laid in June, 1953, but there remained much consolidating work to be done, and it was not until the Port of Mtwara was opened for public business in January, 1954, that traffic was accepted over the Ruo/Mtwara section under "construction conditions." With the opening of the Mtwara/Ruo/Nachingwea railway under normal traffic conditions, the temporary Ruo/Mkwaya link will be closed to public traffic with effect from 1st October, 1954.

The Nab Light

An Unusual Maritime Structure

By DAVID GUNSTON.

Britain's strangest lighthouse, the Nab Tower, is a familiar sight to holiday-makers in the Isle of Wight, at Southsea, Hayling or Worthing, and the first real sight of home for every sailor entering the Spithead channel for Portsmouth or Southampton. This great grey mystery tower, as it has always been known, is something to arouse wonder. It is so incongruous, standing there in the middle of the sea, and so conspicuous that you can see its silhouette on the horizon for miles, that it is bound to attract attention.

But as thousands of people ask every year, what exactly *is* it, and just what is all the mystery about?

It seems incredible that anyone should have been crazy enough to build such a huge tower out there at all—or so it seems, until you discover that no one really intended it to be there at all. And furthermore it was built on land and actually towed there, not built in situ like the better-understood Spithead forts. The mystery of the Nab always deepens until you unearth the story of its strange origin.

In the early months of the last year of World War I, the Admiralty, faced with a critical situation brought about by the almost unchecked inroads of German U-boats into our merchant fleets, swiftly decided upon a number of drastic and revolutionary methods of counter-attack. Most startling was the plan to close the English Channel to all but friendly shipping by sinking a line of six fort-like towers, each costing about £1 million, across the Straits and linking them with steel boom-nets.

The idea looked feasible and within a few weeks two such towers were laid down in a quiet backwater of Shoreham Harbour, Sussex, bringing sudden and short-lived prosperity and speculation to this small Channel seaport. Shoreham was chosen for its seclusion, its nearness to the Channel stream, and its unlimited supplies of shingle for concrete-making. Nothing like this monstrous edifices had ever been attempted before. They were designed to sink in some 20 fathoms by flooding a hollow base, on top of which a 90-ft. cylindrical steel tower would remain above high water. The civilian designer, Mr. G. Menzies, deserves a measure of immortality for his amazingly successful design, which included making the vast honey-combed concrete bases shaped like a ship, with pointed bows and stern, for easy towing out to the chosen spot at sea.

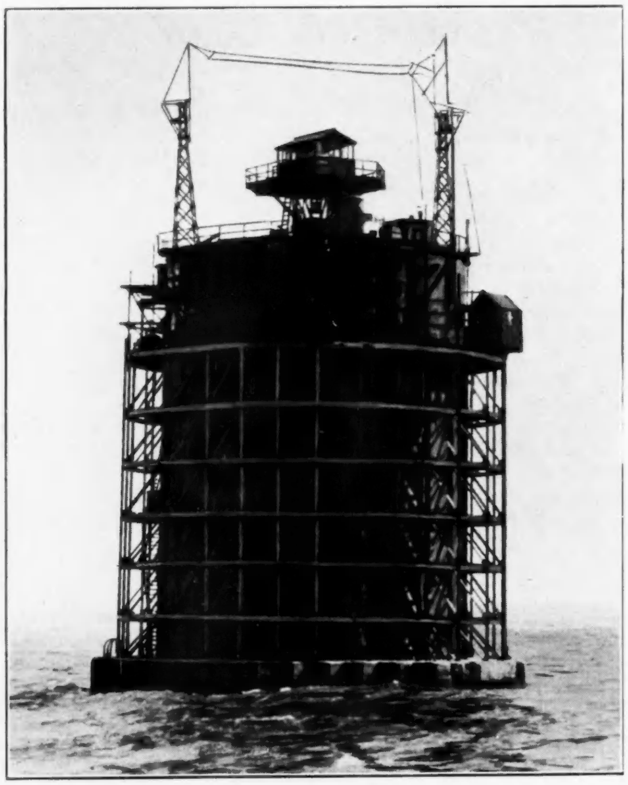
Some 3,000 non-combatant workmen were sent to Shoreham, and soon the towers began to grow; so did the rumours about their purpose, fostered by authorities most anxious to keep the real purpose a secret. "Mystery Towers"—the Press of 1918 had hit upon an epithet that was to cling to one tower over 30 years afterwards. The rumours were even more fantastic than the structures themselves: they were twin grappling towers to be sunk over wrecked merchantmen to salvage them by the simple expedient of pumping air into both; they were tough mobile forts for engaging submarines in mortal combat out in the Atlantic; they were listening columns for detecting the presence of U-boats lurking on the sea-bed. Some

The Nab Light—continued

people firmly believed they were nothing more romantic than supports for a new bridge at Gravesend!

But Germany's collapse on land came in the November before any rumour could be proved right, and the Admiralty was left with a couple of singularly expensive and useless white elephants. Only one tower had in fact been completed, and its half-finished partner was broken up. A naval brainwave decided the fate of the solitary giant: it would be sunk as originally planned, but at the eastern end of the Spithead approaches. There it could replace the old Nab lightship and serve as a naval defence outpost of immense value.

If there were any who doubted whether the structure would ever settle to the bottom of the sea without capsizing (as its proptotype model did during the original construction)—and there must have been many—their fears were first magnified and then finally allayed one specially calm day in 1920, when two tugs made their way out



The Nab Tower.

of Shoreham Harbour with the Mystery Tower floating in tow. The new Nab behaved perfectly and when within a stone's throw of the now dwarfed lightship, her great base was opened to the sea, and down she slowly went, tilting rather alarmingly to one side. But no disaster befell the anxious crowd of technical spectators on the top deck, and before long she had settled firmly on the bottom, kept steady on the rocky tip of the Bambridge ledge from the nearby Isle of Wight by the volume of water inside the base. There she has stood in about 12 fathoms ever since, only once lifting slightly during a winter gale of exceptional force. The one-time U-boat defence had become something almost equally strange, the Mystery Tower had become what every mariner now calls the Nab, in perpetual memory of the not very significant though dangerous Nab Rock a few miles away.

Go right up to the Nab to-day and its sheer bulk is astonishing. It stands most incongrously out of the water, very much like a gasometer with its steel supports and then the few upper feet of its concrete base are seen, and one realises then that it is not floating. Nowadays, it is a busy and vital hub of shipping assistance, merchant as well as naval. When one's boat has finally been made fast to the landing-stage—and that is a difficult and often impossible task in rough weather—one dizzily ascends the iron monkey-ladder up the outside for 80-ft., and finally steps on to the safety-railed top, dominated by two lofty radio masts, and a little glass look-out cabin on a raised platform in the centre. Then, on a lower plane of view, the two great turret-like lights catch the eye. Red to north, white to south, their electric beams flashing one second in every ten must have guided countless ships around the rocks into the deep-water channel for Portsmouth and Southampton. The "Queens" from New York take their turn round the flashing Nab as well as the little dredger from Plymouth Dockyard. In fog a strident warning comes in 2½-second blasts of ear-splitting density from the diaphone fog signal, and if a skipper fails to hear that, there is a massive bell stroke every 7½ seconds.

So far, however, save for its invaluable height above the water, the Nab seems little more than a lighthouse. But to that add its present-day uses as radio beacon for giving directional aid to all ships, reporting those in distress and passing on the thousand-and-one messages that make up the daily routine of the Navy, a radar experimental station constantly trying out new marine signalling devices, a dropping-point for Spithead pilots, and an observation post that can quickly be transformed into an armed fort in an emergency. Deep inside the tower, above the diesel generators that produce the electricity, there is accommodation for 90 men, though in peacetime its crew numbers but three.

With one man always ashore on a month's relief, the select little company of four Nabmen are the chosen few of all Trinity House lightkeepers. Not for them the cramped and swaying lightship, nor the pencil slender lighthouse: their home for two-month spells of duty offers roomy and snug quarters, with space to take plenty of exercise. Nevertheless, the tower is relieved only once a month by tender from Cowes, a visit that means fresh food, new bread, mail, newspapers and a fresh face for the crew who consider it takes them a week again to settle down to their fixed and solitary routine, baking their own bread, living out of tins, and so forth. The loneliness can be as great as that on the most isolated lighthouse, especially in winter, but it is relieved by the close passage of a fascinating pageant of shipping from all over the globe, and the near-regular visits of an Isle of Wight padre who brings creature comforts and conducts a brief service for the Nabmen. But in winter, not even the chaplain can make his regular landings by launch from Bembridge, the rain and wind beating noisily on the metal casing of the tower, while at all seasons the experience of living in an all-metal structure brings its special discomforts of heat and shivering cold.

If the Nab is a lonely place, its little crew are a contented lot, mostly young, with the true lightkeeper's philosophy of lonely contentment, and home-made pleasures like handicrafts. And twice a day there is an informal radio-link-up with all the other keepers round our coasts, an amenity that boosts morale, if that were needed.

The mystery as to the Nab's origins and purpose still clings about its gaunt grey starkness out there in the middle of the sea, but it remains a unique tribute to British ingenuity, skill and enterprise.

Ocean Research by N.Z. Scientists

It is reported from New Zealand that in the next few years, the Department of Scientific and Industrial Research will gather a team of scientists to study ocean waters around the Dominion. Research will be undertaken in the fields of biology, physics and marine geology, and the work will embrace the area of the Cook Islands, Fiji and Samoa. The team will study the behaviour of the main currents affecting New Zealand from season to season, by measuring the temperatures and the salinity of the water at the surface and at depth.

The Department is of the opinion that an understanding of the seas around New Zealand forms the essential background for future investigations for fisheries' and local problems, such as the silting of harbours and water movements in difficult navigational areas such as Cook Strait. Preliminary work in the study of biology, physics and marine geology has already been completed, and the results of four years' research on surface temperature distribution in the South West Pacific are now being published.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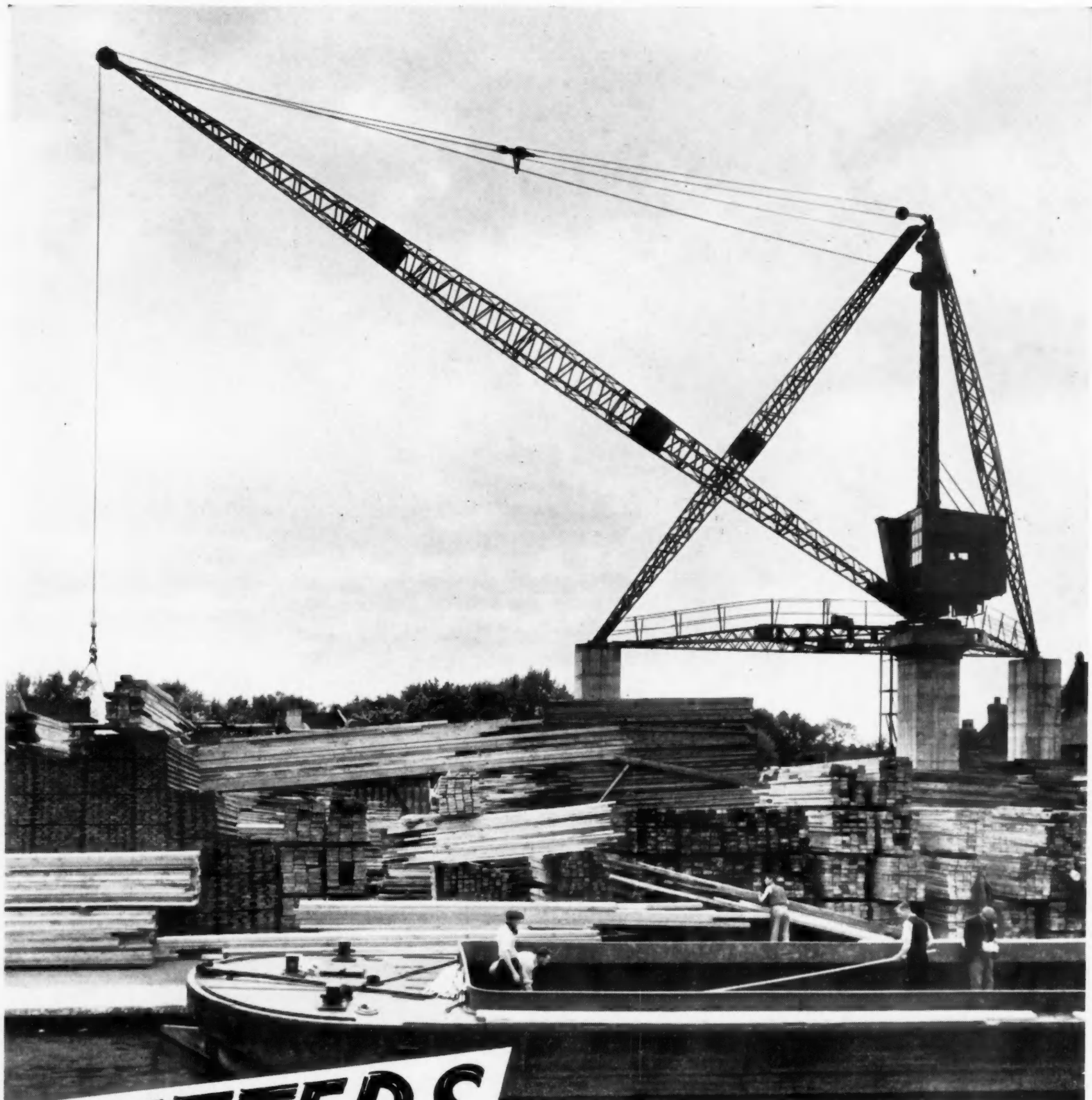
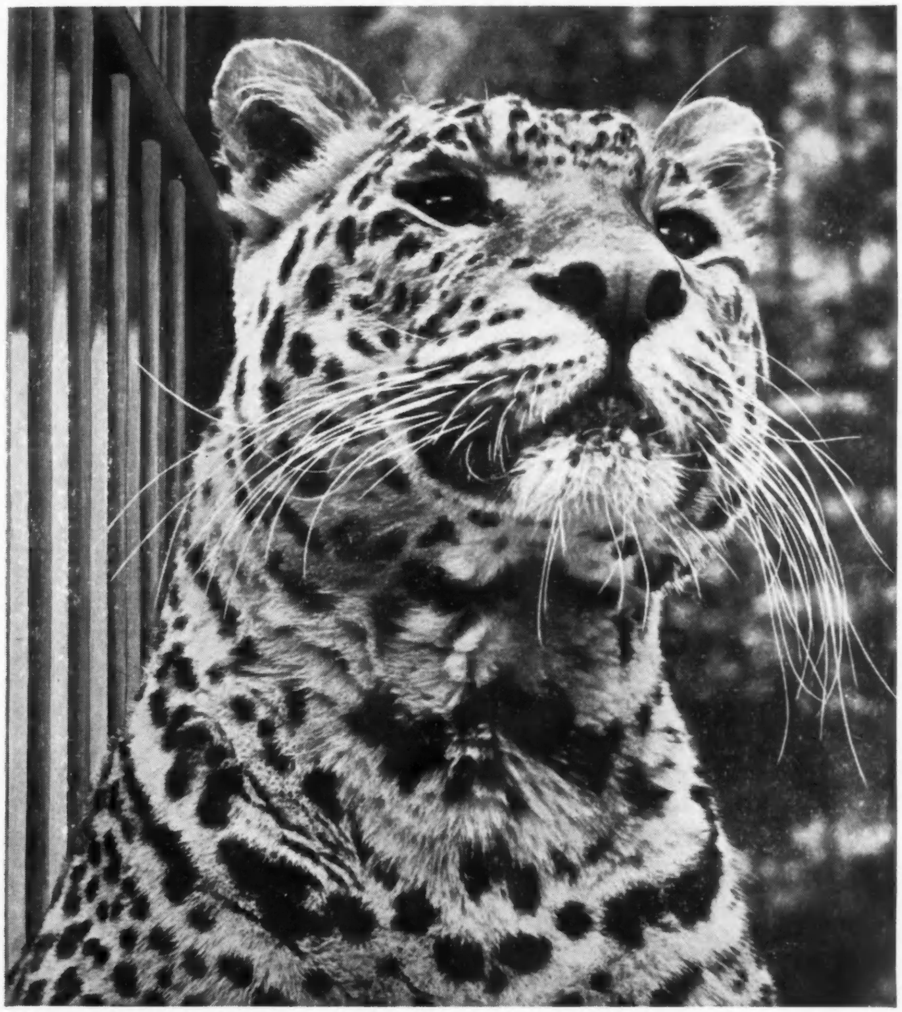
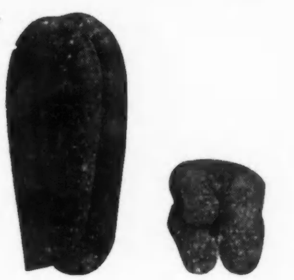






Beacons as Navigational Aids

Their Application to Ports and Harbour Approaches

By CAPT. H. V. HART, R.N.R. (Retd.).

NAVIGATION within coastal waters largely depends, both for the primary regard for safety and the modern requirements for rapid transit, upon the establishment of a number of navigational aids. These aids are both static or fixed in character, and are provided in the forms of lighthouses and other shore beacons; lightships and floating beacons, the latter being usually referred to as buoys.

These navigational aids are requisite in order to give the mariner warning of hidden dangers, i.e., rocks, shoals, sandbanks, etc., when navigating within coastal waters, and also to assist in the safe guidance of vessels within the restricted areas of the approaches, channels, rivers and entrances to ports.

Fixed aids to navigation are provided by the establishment of lighthouses and other beacons on salient points of a coast, and also upon the sites of outlying dangers, which constitute a particular menace to shipping and where, by reason of their exposed positions and other conditions, it would be difficult to provide any alternative form of warning of sufficient reliability to ensure safety to vessels navigating within their localities.

They also include all the necessary navigational marks as established on harbour and dock entrances, piers, river wharves, stages, laybyes, bridges, etc., and any works under construction, as protruding into navigational waters, and constituting an obstruction thereto.

Floating beacons and all other similar navigational marks, and inclusive of lightships, are within the classification of buoyage, which term refers to them collectively and as comprehensive of the establishment of a series of such, as provided for navigational purposes.

In order to be fully effective in providing assistance towards shipping, buoyage should be of universal and international uniformity, with distinction in the numerous shapes, colours and lighting character of all navigational aids, so as to afford rapid and accurate determination by the mariner of the particular purpose for which each individual mark is placed in its respective position.

Buoyage may be divided into two separate sections, viz.:—

(a) Outer buoyage, as providing indication of the presence of dangers when navigating along a coast, or in coastal waters.

(b) Inner buoyage, as established in restricted waters, i.e., in the approaches to a port and sea channels thereof, where its estuarial nature maintains diverse and intricate channels in which shoals and other dangers may be interspersed, and in the waters and rivers which are immediately adjacent to such ports.

Historical Association of Navigational Aids

The term "beacon" is suggested to be of Gothic and Germanic origin, as an expression of a sign or token of danger.

The more general term of "buoy," as generally applied to all floating beacons, is derived from the Latin boia, and although the exact period in which buoyage first became practised is obscure, yet mention of buoys is made in a classical quotation: "*Boiæ genus vinculorum tarn ferreæ, quam ligneæ.*" (A form of buoy, bound with both iron and wood.) It is also mentioned by Plautus: "*Boia est, boiam terit.*" In 15th Century English the word was spelt as *boye*, and in Hakluyt's navigational works as *bwoy*.

It is therefore a reasonable assumption that buoyage existed in early times as a means of marking isolated dangers, although it is improbable that any definite system was in force.

Dating of the origin of buoyage in British waters is also doubtful, but it is on record that the rivers Thames and Tees were buoyed more than 300 years ago, and certain maritime paintings depict buoys in their subjects as extending back over 100 years beyond the above period. The original and most historically famous shore beacon was the Pharos Light beacon, erected in 280 B.C. by Philadelphus Ptolemy on the site of the modern Alexandria, Egypt. This beacon was said to be 600 feet in height and its summit was lit by a brazier. The lighthouse was subsequently destroyed by earthquake in the 13th Century. Prior to the reign of Henry VIII, coast lighting, as it then existed, was commonly undertaken by private persons or by charity, and church towers constituted the usual form of beacons as used for this purpose. Credit for the establishment of the first lighthouse in British waters, and erected on a prominent outlying coastal danger which had been the cause of numerous previous shipping disasters, must be awarded to Henry Winstanley, who, in 1698 designed and built, largely by personal labour, the Eddystone Lighthouse, situated some fourteen miles seaward of Plymouth, on the rocks of that name. During the course of building operations, Winstanley was captured on the actual site by the French (a privateer vessel), and upon presentation to the French King, as a captive of note, was most chivalrously released and repatriated by him, as "a contributor to international safety of shipping".

This lighthouse consisted of a timber structure strengthened by iron supports, and in spite of dismal forebodings remained in being for several years, until eventually destroyed in an exceptionally heavy gale with the loss of many lives, including that of the designer. This lighthouse was followed by one of Rudyard's design, to be shortly afterwards destroyed by fire.

In 1759 this was replaced by Smeaton's and existed until 1881, when it was demolished, consequent upon erosion of the rock.

The present lighthouse was built by Douglas in the same year. Other similar and prominent marks established around the coasts of the British Isles are: Wolf Rk., Bell Rk., Bishop Rk., Skerryvore, etc., as characteristic of marks for outlying dangers.

As major landfall marks, St. Catherine's and the Lizard lighthouses are prominent, the latter constituting the first light encountered by most vessels making the English Channel.

Buoyage and Lighting Authorities

Modern conditions of navigation, wherein the time factor largely contributes to successful economic operation of shipping, require that (practically) all navigational marks shall be lighted, and at the present time there exist some 600 major and 1,000 minor lights on the coastal shores of the British Isles.

Authority for the administration, maintenance and operation of all navigational lighting, together with that of the enormous numbers of buoys as established round the coasts, is vested in two separate Authorities. These are Trinity House (London), which exercises authority over the areas around the English coasts; and the Commissioners for Northern Lights, who control the same offices over Scottish waters and those of Northern Ireland.

The former, although originating as a semi-religious or charitable organisation, became first established in its secular status, and an Authority as pertaining to its existent duties and responsibilities by a charter granted by Henry VIII in 1514 as "a body of mariners concerned with the necessary duties as relating to navigational matters". The present title of Trinity House, Deptford, Stroud, was then adopted, to complete the severance from its former character. In the 19th Century it became invested with the entire and exclusive responsibility for the operation of all buoyage and lighting, in conjunction with pilotage, and many other important duties in connection with shipping.

Early Lighting Systems

Previous to 1822 the illumination of all fixed beacons (lighthouses, etc.) was effected by the use of coal fires in braziers, and it was not until 1870 that this primitive form of illuminant became displaced by the introduction of coal gas, which soon became

Beacons as Navigational Aids—continued

extended to use in connection with buoys. It was also then that the previous character of "fixed" lights was gradually supplanted by variations, by the introduction of occulting and flashing characters, the latter being adjusted to several differing forms.

Early in the present century the general principle of the use of dissolved acetylene gas, as a source of illumination, became almost universally adopted, and shortly afterwards electric lighting, which for some time previously had been established in lighthouses as an improvement on gas, was introduced into buoy lighting.

Universal International Systems of Buoyage Conferences

Prior to 1882 there existed no attempt at any uniformity in the buoyage systems as adopted by the various countries or by local buoyage authorities. The systems as severally adopted were of an entirely individualistic character, as considered to most efficiently conform to the requirements of peculiar geographical and local conditions and circumstances. These diverse practices with regard to buoyage constituted a serious navigational problem to mariners navigating within both home and (especially) foreign waters, if without the assistance of local pilots, who were often unofficial and not always available in certain lesser foreign ports.

In 1882, therefore, a conference was held at Trinity House under the presidency of H.R.H. Duke of Edinburgh, the terms of which were: "To investigate proposals for the establishment of a uniform system of buoyage".

This conference was composed of representatives of various interested Authorities and "specially" considered the questions of colours, visibility, shapes and sizes of buoys, and eventually evolved a more or less elastic system, to be subsequently adopted as uniform by the U.K., and later extended to India and the Dominions. In 1889 the first International Buoyage Conference was held in Washington, U.S.A., and was represented by the majority of maritime countries, including China, Siam and Uruguay.

Recommendations were made for the adoption of an international "Lateral" system of buoyage, to be primarily based on "colour," i.e., all starboard hand buoys to be coloured red; and all port hand buoys to be coloured either black or parti-coloured. The use of spherical shapes for middle ground buoys to be definitely excluded. With these recommendations, however, the U.K. did not concur and did not depart from the previously adopted system.

In 1912 a further conference was held in (then) St. Petersburgh, at which the U.K. was unrepresented. At this conference a reverse proposal to that made at the Washington Conference with regard to the "colour" system was advocated, but was only adopted by S. Russia, Spain and Italy.

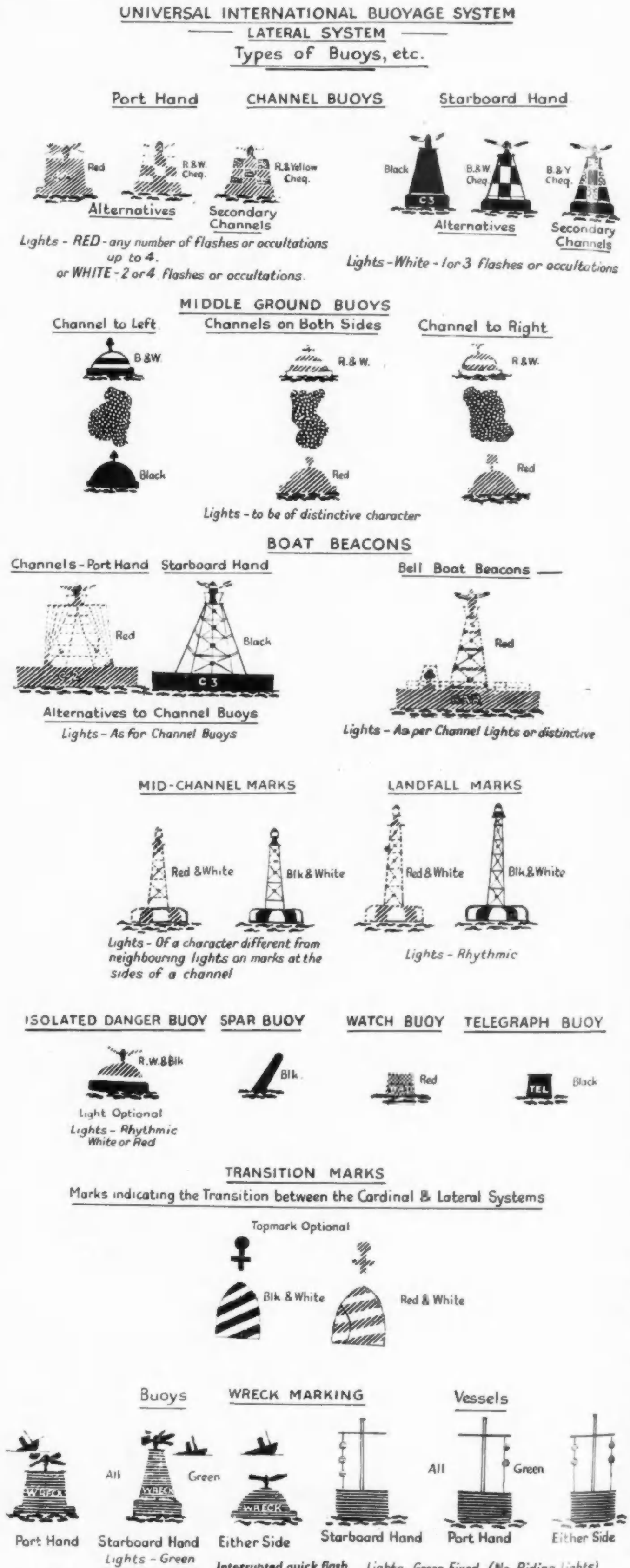
This decision was principally due to the fact that the coasts of several countries, and notably those situated on the Baltic Sea, were unsuited to the "lateral" system of buoyage. This system is in general use for well defined channels, wherein the buoyage marks indicate the lateral limits thereof by the dispositions of buoys on both sides. They also indicate positions of danger, in relation to the routes to be followed by mariners, in their vicinities.

This unsuitability was largely due to the numerous intersections and bifurcations of their numbers of separate channels and waterways, wherein strong tides and currents habitually prevailed.

These waterways, too, were often interspersed by innumerable islets, rocks and other similar obstructions, which rendered the "lateral" system impracticable, and navigation both difficult and hazardous. Such countries therefore preferred the "Cardinal" or "Compass" system of buoyage, which is generally used to indicate dangers existing in confined coastal waters. In this system, the bearing (true) of the navigational mark, from the danger, is indicated to the nearest cardinal point of the compass.

The buoys used under this system also indicate the bearings of dangers by means of a combination of shapes, colours and top marks (especially the latter).

Countries concerned with the cardinal system were Norway, Sweden, S. Russia, Germany, Italy and Turkey, with, however, the additional use of the lateral system by the three last mentioned countries. The rules allow the use of both systems in the same country, according to preference or local requirements, provided that the limits of their respective uses are clearly indicated in



Beacons as Navigational Aids—continued

nautical documents and, if necessary, by appropriate marks positioned at the junctions of the separate systems.

The British view with regard to exceptions to the lateral system was that buoys do not constitute essentially reliable sea marks as indications of danger, and, as such, are merely additional aids to navigation and should in all cases be treated with cautionary care as to their correct positioning. It was only necessary, therefore, for buoys to conform to a simple uniform shape; to be identifiable on the chart; and that uniformity in "colour" was of secondary consideration to that of "shape," which latter characteristic should constitute a rapid means of determination of different channels, etc., in an estuary by the mariner.

At that conference the various systems of buoyage and lighting, as in common adoption, were approved. These were:—

U.K.—White lights on starboard hand; red lights on port hand.

U.S.A.—The reverse of the above.

Red lights were permissible in open waters, but owing to their reduced ranges of visibility and other disadvantages should only be adopted as of a specially distinctive character, as compared with white lights, and their use should be confined to port hand buoys. Lights coloured green to be exclusively reserved for wreck marking.

The lateral system continued in the U.K. without any modifications until 1922, when another conference was convened at Trinity House, to "review the sections of the former schemes, as relating to the buoying and marking of wrecks." At this conference a scheme was recommended, and subsequently adopted throughout the U.K., subject to a few modifications, confirmatory of the main sections of the former scheme. The principal alteration consisted of a definition of the term "from seaward," which term was defined as "in the direction of the main stream of flood tide," and of which examples were given for various districts, wherein interpretation of their definition might be doubtful, around the coasts of the U.K. The above term was defined so that no uncertainty might exist in the mind of the mariner as to the correct interpretation of "starboard" and "port" hand buoys respectively.

The recommendations of this conference were as follows:—

(1) Mariners approaching a coast must determine their position on the chart and note the direction of the main stream of flood tide.

(2) The term, "starboard hand," denotes that side on the right hand of the mariner, either going with the main stream or approaching a harbour, river or estuary from seaward.

The term, "port hand," denotes the left hand of the mariner, as above.

(3) Buoys showing the pointed top of a cone above water are called "conical" and are always starboard hand buoys.

(4) Buoys showing a flat top above water are called "can" and are always port hand buoys.

(5) Buoys showing a domed top above water are called "spherical" and mark the ends of middle grounds, i.e., shoals, etc., in mid-channel.

(6) Buoys having a tall central superstructure on a broad base are called "pillar" buoys and like all other special buoys, i.e., bell, gas, automatic sounding buoys, etc., mark special positions on a coast or in the approaches to harbours.

(7) Buoys having a mast above water are called "spar" buoys and are usually used in waterways which are subject to the presence of floating ice during seasonal periods, and in channels in which high velocity tides and currents are prevalent.

(8) Starboard hand buoys are painted a single colour.

(9) Port hand buoys are painted either a single colour or parti-colour.

(10) Spherical buoys are distinguished by white horizontal stripes.

(11) Surmounting beacons on buoys, e.g., staff and globe, are painted a single dark colour.

(12) Staff and globe, is only placed on starboard hand buoys.
Staff and cage, is only placed on port hand buoys.
Diamonds, to mark the outer ends of middle grounds.
Triangles, to mark the inner ends of middle grounds.

(13) Buoys established on the same sides of channels may be distinguished by names, letters or numbers.

(14) Mooring buoys may be of any colour (green excepted) and shape, at the discretion of the buoyage authority.

Telegraph cable buoys are coloured black and marked "telegraph" in white letters.

Buoying and Marking of Wrecks

All wreck marking vessels and buoys to be green in colour, with the word "wreck" in white letters.

Lights.—Buoys by Night shall exhibit:—

(a) Port hand buoys to be can shaped and exhibit two green flashes.

(b) Starboard hand buoys to be conical shaped and exhibit three green flashes.

(c) Either hand buoys to be spherical shaped and exhibit a single green flash.

Wreck Marking Vessels by Night shall exhibit:—

To be passed on the port hand—two vertical green lights.

To be passed on the starboard hand—three vertical green lights.

To be passed on either hand—two vertical green lights, on each side.

By Day.—Green balls, or shapes, to be exhibited in the same characters as the lights.

During thick weather a bell shall be rang twice in succession every thirty seconds.

In reviewing the above recommendations, the obvious omission therein is that of uniformity in colour for buoys on opposite sides of a channel; also of a definite form of lighting for same, which is left to individual discretion, and which not infrequently gave rise to the anomalous position of two ports situated closely together having reverse colour and lighting characters for their main channel buoys. It is also noticeable that the character of the fog bell is apt to be most misleading, and gives no indication of which side the buoy is to be passed.

At this conference the first definite and universal system of wreck marking was achieved and the introduction of a definition for the terms, starboard and port hand, effected.

Although, therefore, as a result of these various conferences, a certain standard of uniformity in buoyage was recommended and ratified by the several countries involved, yet the factual implementations of such remained of considerable elastic proportions owing to insistence on the part of several participants of special and permissible exemptions from the rules, on the plea of local conditions. The inevitable result, therefore, of these exemptions from uniformity was to largely nullify the terms of the conference.

At this conference a further caution was issued with regard to the feasibility of floating marks as danger warnings.

In 1930 a further Buoyage Conference was held in Lisbon, at which most maritime countries and lighting authorities were represented, and where, with certain minor modifications, the recommendations of the previous conference were approved and confirmed.

In 1936 another conference of international attendance was held in Geneva, at which the U.K., Belgium, India, China, Sweden, Russia and others were represented. The terms of the previous conference were agreed to and were proclaimed open to accession by the parties concerned in 1937, and such accessions were to be transmitted to the Secretary General for the League of Nations for international ratification.

Among the recommendations adopted by this conference was the proviso that departures from the amended routes should only be permitted in virtue of local conditions, or exceptional circumstances, and more particularly where the adoption of the rules in question might endanger navigation or necessitate an expenditure

Beacons as Navigational Aids—continued

out of proportion to the nature and volume of traffic making use of a harbour or port.

The recommendations of this conference were as follows:—

(*1*) *Definitions.*

The marks to which buoyage regulations apply include all fixed and floating marks, other than lighthouses and lightships, as serving to indicate:—

(a) The lateral limits and axes of navigable channels.
(b) Natural dangers.
(c) Wrecks and similar obstructions.
(d) Certain other points of importance to mariners, e.g., landfalls.

(*2*) *Method of Characterising Marks.*

The characteristics of the principal types of floating marks are shown either by the shape of the upper part of the body of the mark, or by the shape of the superstructure.

(*3*) *Characters, etc., of Buoys to be as follows:—*

(a) Starboard hand buoys to be conical in shape, with cone uppermost, and to be painted black, or black and white chequers in colour.

Topmarks (if any) to be a black cone, point uppermost, or black diamond.

Lights. White flashes or occultations, to be of an uneven number of same. The alternative colours of green, or combination of both white and green lights are permissible if arranged of different characters from those allocated to wreck marking.

If buoys are numbered, the numbers are to be uneven.

(b) Port hand buoys to be can shaped, with flat top uppermost, and painted red or red and white chequers, in colour.

Topmarks (if any), red can or red T.

Lights. Red flashes or occultations, to be of an even number of same. The alternative colours of white lights of the same character, or a combination of both white and red lights are also permissible.

If buoys are numbered, the numbers are to be even.

(*4*) *Middle Ground Buoys* to mark a shoal in a channel, and having channels on both sides of the shoal, to be spherical in shape, with red and white horizontal bands in all cases where the main channel is to the right, or where both channels are of equal importance.

A spherical buoy with black and white horizontal bands where the main channel is to the left of the shoal.

Topmarks. Where channel is to the left: outer, black cone; inner black diamond.

Where channel is to the right: outer, red can; inner Red T.

Where both channels are equal: outer, red sphere; inner red St. George's Cross.

(*5*) *Mid-channel Marks* to mark the centre of a navigable channel to have distinctive shapes, i.e., conical or pillar, with black and white vertical stripes, or red and white vertical stripes.

Topmarks (if any) to be of distinctive colour, other than cone, can or sphere. (A St. George's Cross is suggested.)

(*6*) *Isolated Danger Marks* to be spherical in shape, with wide black and red horizontal bands, separated by a narrow white stripe.

Lights (if any), white or red flash.

(*7*) *Landfall Marks* to be as far as possible in accordance with channel markings and may be pillar in shape, with either black and white, or red and white vertical stripes.

Topmarks—none.

(*8*) *Pillar Buoys* should consist of a tall central structure on a broad base, and are used to mark special positions on a coast or in harbour approaches.

(*9*) *Spar Buoys* have only a mast above water and are generally used to mark special positions, e.g., a spit.

(*10*) *Watch Buoys.* These are often placed near a lightship, which is in position out of sight of land, in order to indicate whether the vessel is dragging her moorings. They are can shaped and red in colour, with the word " Watch " in white letters.

(*11*) *Wreck Buoys and Wreck Marking Vessels.*

NOTE.—The colour green is exclusively used to denote wrecks. Wrecks may be marked according to both lateral and cardinal systems, but the system in use in each country must be notified in nautical documents.

Buoys—Lateral System.

If to be passed on the starboard side—to be conical in shape and green in colour. Light (if any), triple flashing green.

If to be passed on the port hand—to be can shaped and green in colour. Light (if any), double flashing green.

If to be passed on either hand—to be spherical in shape and green in colour. Light (if any), quick multiple flashing green.

Wreck Marking Vessels—by Day.

If to be passed on the mariner's starboard hand—3 green balls or shapes.

If to be passed on the mariner's port hand—2 green balls or shapes.

If to be passed on either hand—2 green balls or shapes, on each side.

(All shapes to be disposed vertically.)

Lights.—Fixed green, to correspond in numbers, and arrangement, to the shapes mentioned above. Watch vessels do not exhibit riding lights.

Sound Signals in thick weather. A bell to be rung at intervals, not exceeding 30 seconds, as follows:—

Three strokes, if to be passed on the starboard hand.
Two strokes, if to be passed on the port hand.
Four strokes, if to be passed on either hand.

(*12*) *Bell and Whistle Buoys.*—These are fitted with a mechanically operated bell, or whistle, and marking isolated or important positions, as aids to navigation in thick weather.

(*13*) *Submarine Telegraph Buoys* to be coloured black, with " Telegraph " in white letters.

(*14*) *Mooring Buoys* may be of any shape or colour (except green) at the discretion of the local authority. Aircraft mooring buoys are large and padded, and are fitted with a " picking-up " strop.

(*15*) *Radar Reflecting Buoys* reflect back an echo to the transmitting vessel in order to give warning of their presence, or to afford distinction of a " particular " buoy, in a buoyed channel.

In examining the above rules, it is noticeable that exact discrimination in the colours of lights on the two sides of a channel, as in conformity with buoy colours, is still absent and allows continuance of the anomalous situation as previously existing. It is further complicated by the introduction of green into channel lighting as an alternative, which, in spite of differentiation in character from those lights as reserved for wreck marking, is liable to lead to confusion by the mariner. In 1948 another international conference was held in Paris, when several modifications and amendments were made in the rules. These have now been adopted by Trinity House, Northern and Irish Lights Commissioners, and the principal Port Authorities, and implemented within their respective areas of jurisdiction.

The principal amendment consists of the abolition of the previous alternative of mixed green and white lighting for starboard hand channel buoys, the colour of which is now confined to white only, of a character of an uneven number of flashes.

White lights remain as alternatives for red in port hand channel buoys. If used, these white lights must exhibit an even number of flashes.

This amendment now therefore exclusively reserves the colour green for wreck marking and removes a possible source of confusion to the mariner when (as previously) navigating a channel in which a number of green lights were established for other than the generally recognised purpose of wreck marking.

Another alteration is the substitution of a quick flashing or " scintillating " green light (240 flashes per 7 secs. or 10 secs.) of group character, for the previous single flashing light on spherical wreck buoys. This character of light is extremely distinctive, but of a much reduced range of visibility.

(*To be continued*)

Pier and Dockside Fenders

Application of Rubber in Various Types *

By A. R. SMEE, C.B.E., M.I.C.E.

The fender, as its name implies, is the medium used on jetties, piers and wharves to damp out the shock of vessels coming alongside to berth and also to afford protection whilst the ship remains at her berth. The provision of efficient fenders is a matter of concern to both parties involved—the ship owner, and whoever is responsible for the maintenance of the pier or wharf concerned. Where small vessels of the tug, lighter or barge types are concerned, and where they are berthing at small steel or timber jetties, the chances of damage to vessel and jetty may be about equal, but this is far from being the case when ocean-going vessels come in to berth against concrete wharves or quays. The wharf is solid and the ship is hollow, and severe damage to the vessel can and does result from any error or mischance as she comes alongside. The larger the vessel, the more vulnerable she is to damage, as, although the plating of a 30,000-ton† liner may be a good deal thicker than that of an 800-ton coasting vessel, the relative thicknesses bear no relation at all to the difference in tonnage.

Weight and Speed.

Liability to damage is dependent upon two factors—the weight of the vessel, and its speed and angle of approach. The basic formula for Kinetic Energy is $WV^2/2g$. The energy contained in the vessel, and which has to be damped out, therefore rises as the square of the speed. A dead slow approach at right angles to the face of the wharf is always aimed at, that is, for the vessel to move in bodily sideways without either ahead or astern way. An approach speed of 6-in. (15 c.m.) per second may not look appreciably slower than one of 12-in. per second, but at the latter speed the impact will be four times as great as at the lower rate of approach. Even a slight error of judgment can result in severe damage to the plating, and possibly even to the framing of the vessel unless cushioning can be provided by adequate resilience in the fenders. A further complication is that it is not always possible to ensure that a vessel coming into berth has neither ahead nor astern movement, and fenders must be capable of receiving glancing blows. In addition, whilst moored up, a vessel is subject to the vagaries of wind pressure, tidal action and movement due to sea and swell.

Simple Fenders.

Many type of fender are in common use. The most simple form generally consists of baulks of timber fixed to the face of the shore structure, and actual resilience is supplied by old tyres, rope fenders or bundles of brushwood. In other cases protection is achieved by driving in a row of piles in front of, and clear of, the jetty face, the flexibility of the pile insulating the main structure from shock. Dummies, or catamarans, which are also in common use, are, in effect, floating rafts of heavy timber which are positioned between the ship and the dock wall. A modern development is the gravity fender, which consists of concrete blocks hung on chains or links below the deck of the quay or jetty. The faces of these blocks project beyond the face of the quay, and as a vessel comes in to them they are pressed inwards and upwards on their hanging supports and tend to exert an outward pressure on the side of the ship, and keep it clear of the quayside.

Experiments were made before the last war to produce fenders in which resiliency was provided by the use of rubber. Such experiments had perforce to be discontinued during the war, when rubber was in desperately short supply, but since it has been freely available once more, consideration of applying it to fenders has been resumed and is receiving increased attention. The present article, however, describes only three types of fender incorporating rubber.

Brodick Pier.

Brodick Pier is situated on the Isle of Arran, and receives the traffic from the Clyde steamers. The pier itself is of reinforced concrete, and is too rigid to absorb any impact. The system of resilient fenders adopted is to the design of Messrs. Blyth & Blyth, Consulting Engineers, Edinburgh, and consists of greenheart fender piles driven along the face of the pier although clear of it. The bottom end of the piles is driven some 8 feet into the sea bed, and the top end is positioned against a rubber block which is secured to, and abuts against, the pier. The piles, although free standing, are braced longitudinally by heavy whalings and impact on one pile will therefore be distributed to adjacent piles. The rubber fender blocks were supplied by the Avon India Rubber Co., Ltd., and each is calculated to deflect between 2 and 2½-in. (5.1 and 6.3 c.m.) under a load of 10-15 tons, which is sufficient to absorb the kinetic energy of the vessels using the pier when approaching at normal berthing speeds.

Fig. 1. Rubber fender block made by Avon India Rubber Co., Ltd. This type of fender was used at Brodick Pier.

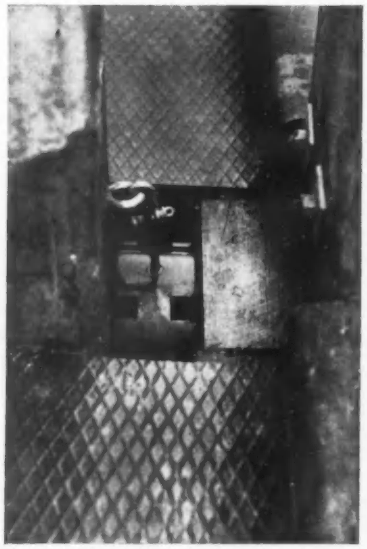


Fig. 2. Looking down on the fender block in position at Brodick Pier.

Figs. 1 and 2 show the simplicity of the design, which has proved effective under working conditions. After some three years in use the rubber blocks were, in a recent inspection, found to be in excellent condition, and showing no signs of wear and tear. The degree of resilience provided is reported to be "amply adequate for the prevention of damage to the structure and the steamers."

Canvey Island.

An unusually interesting design of a shock absorber for pile fenders is now under construction by the Andre Rubber Co., Ltd., for use at the Canvey Island oil storage depot of the Regent Oil Co., Ltd. These shock absorbers make use of the system invented by a Swedish engineer, H. J. Neidhart, for which the Andre Rubber Co. are the sole concessionaires for Great Britain and the Empire. The principle of the system can be understood by reference to Fig. 3, showing a demonstration unit. It consists of a square box with rounded corners in which a square shaft attached to a lever arm is free to rotate. In each of the four corners of the box a rubber unit, originally circular in section, is inserted, which is pressed into a roughly triangular shape by the corners of the box and the face of the square shaft. If the lever actuating the shaft is moved in either direction, the four rubber units are subjected to what may be described as "rolling compression," and resistance builds up rapidly. The stiffness of the unit is, of course, capable of wide variation, either in the design of the metal parts, or by altering the Shore durometer harness of the rubber.

* Reprinted from a recent number of "Rubber Developments."
† The British long ton of 2,240 lb. is approximately equal to the metric tonne.

Pier and Dockside Fenders—continued

The application of these shock absorbers to fender piles is shown in the diagrammatic sketch (Fig. 4), from which it will be seen that the pile head is attached to the jetty structure by a system in which the lever arms of the shock absorbers form a linkage resulting in the operation of eight shock absorbers when the pile head is deflected. It will be noted, too, that the arrangement is such that the pile head will deflect under a glancing blow as well as one which is head on.

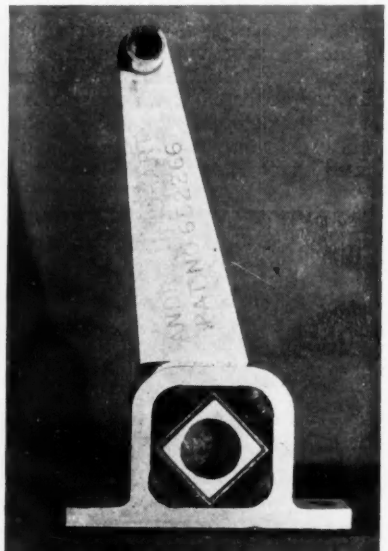


Fig. 3 (left). "Andre-Neidhart" shock absorber demonstration unit.

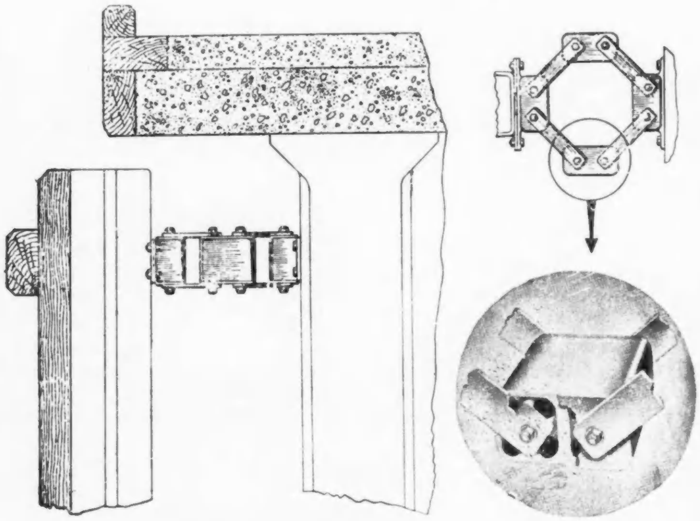


Fig. 4 (right). "Andre-Neidhart" shock absorber applied to fender pile.

The degree of protection afforded to both vessel and shore structure by this application of the Andre-Neidhart principle should be of a high order, and its behaviour under working conditions will be followed with interest. It is obvious that this shock-absorbing system will have a multitude of other applications.

Southampton Docks.

The Union-Castle Mail Steamship Co., Ltd., have in use at Southampton two prototypes of a resilient fender known as the Tweddell Compression Fender, the invention of Captain A. J. Tweddell, Assistant Marine Superintendent to the Line. These fenders are of the floating type known as dummies or catamarans, and, as noted previously, they are normally constructed of baulks of timber protected on the seaward face by old rubber tyres, rope fenders or the like.

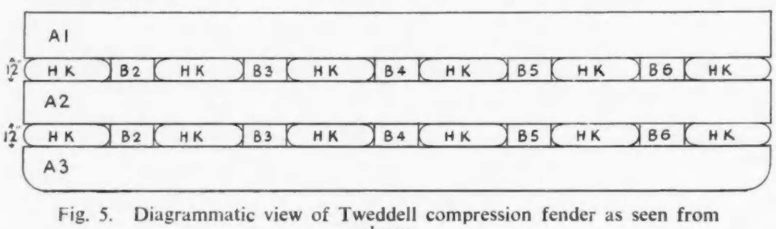


Fig. 5. Diagrammatic view of Tweddell compression fender as seen from above.

In Captain Tweddell's invention the dummy is provided with internal rubber compression chambers which permit it to contract and expand over its whole length to a total movement of some 18-in. (45.7 c.m.).

The diagram (Fig. 5) shows the general appearance of one of the prototype dummies which, in its experimental form, uses old motor tyres as its compression chambers. The dummy can, of course, be constructed to any size required, but for ships of 20,000 to 30,000 tons a length of some 30-ft. (9.1 m.), a breadth of about 6-ft. (1.8 m.), and a depth of some 4-ft. (1.2 m.) are serviceable dimensions. The dummy floats with its upper surface very little above water level; the compression chambers are therefore largely immersed.

For a dummy built, like the prototypes, with two lines of compression chambers, the form of construction is as follows:

By referring to the diagram, it will be seen that the dummy consists of three lines of timber baulks, A1, A2 and A3, each line being some 12 inches distant from the other. The three lines are held together as a firm framework by heavy cross timbers B2, B3, B4, B5 and B6, fixed rigidly at intervals to the centre line A2, but recessed into the timbers of the outer lines A1 and A3 in such a manner that, whilst the outer lines of timbers can be pressed inwards, they are restrained from outward movements beyond the original predetermined spacing of some 12-in. (35.5 c.m.). The compression chambers marked HK are fitted into the recess formed by the longitudinal and side members.

These compression chambers consist of two units, an inner and an outer unit. The outer unit resembles the outer cover of a motor tyre, except that in place of the continuous opening around the inner circumference there are a series of holes only, these being to allow the ingress and egress of air and water. The inner unit fits into the outer in the same manner as a car wheel, but it is a slack fit, and the unit is of solid rubber slightly wider than the outer "tyre," and designed to fit closely into the 12-in. wide recesses between the three rows of timbers.

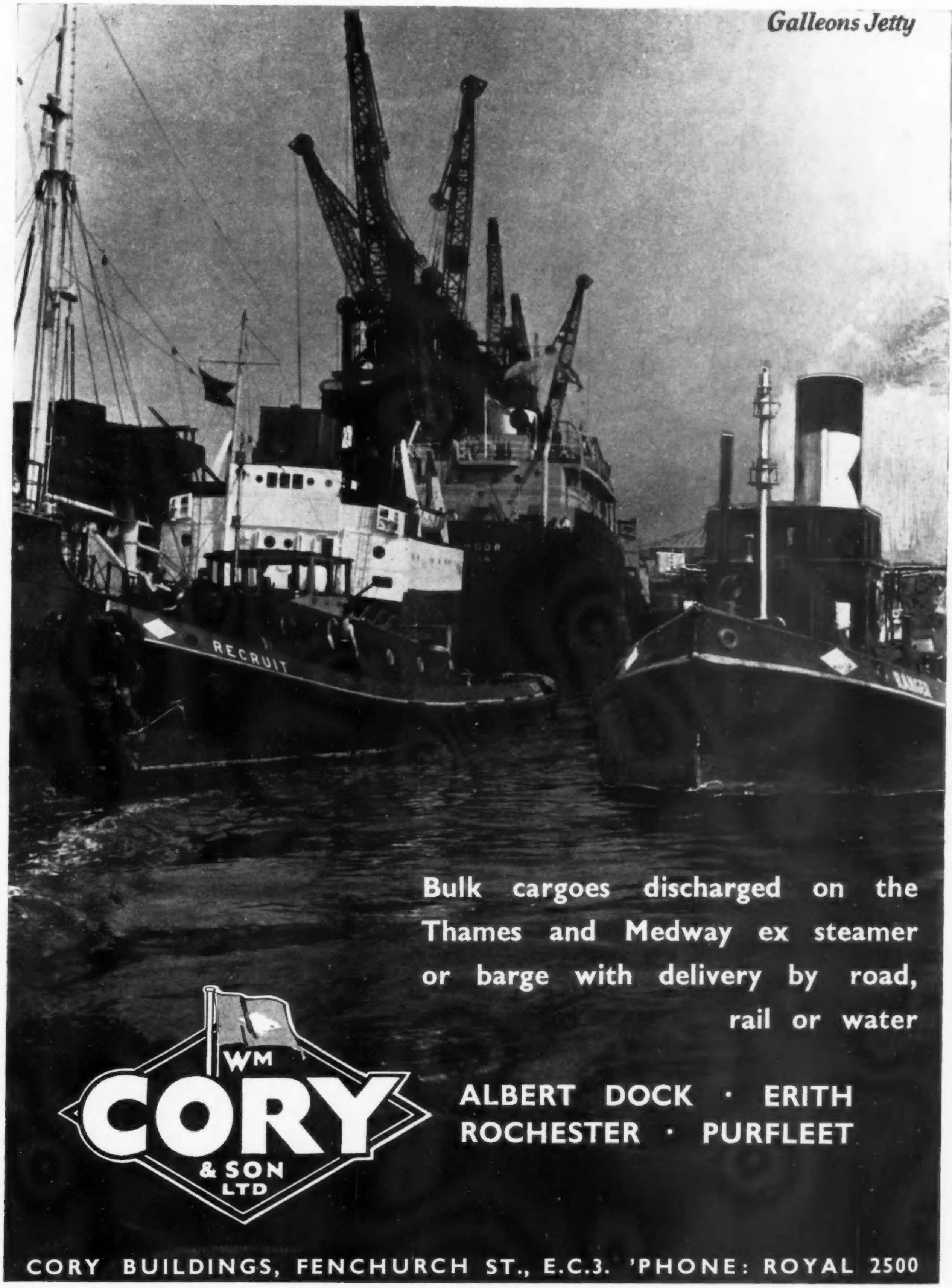
Concertina Effect.

A vessel pressing against the Tweddell Compression Fender tends to concertina the three lines of timbers together. This tendency is first resisted by all the solid rubber inner units, but as they are compressed, the outer units, filled with air and water, come also under compression. The inner units, however, increase their diameter as they are squeezed, and as they come into contact with the outer unit, they restrict the egress of the air and water through the vent holes of the outer chambers. Pressure therefore builds up rapidly, and an efficient shock absorber is formed. Removal of the pressure by the ship results in the solid rubber inner units thrusting the baulks of timber back to their original position and so allowing the outer compression chambers to expand and refill with air and water.

The prototype compression fenders were inspected last July after two years' testing, and it was stated that they had given complete satisfaction, and that the original tyres were still in use.

The Port of Kingston, Jamaica

The port authorities at Kingston, one of the finest natural harbours in the world, are seeking Government aid to modernise the berths and docks. Recently some shipping companies have expressed concern at the lack of adequate facilities to accommodate the large modern liners now making Kingston a regular port of call.


Galleons Jetty
RECRUIT
Bulk cargoes discharged on the Thames and Medway ex steamer or barge with delivery by road, rail or water
WM
CORY
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LTD
ALBERT DOCK · ERITH
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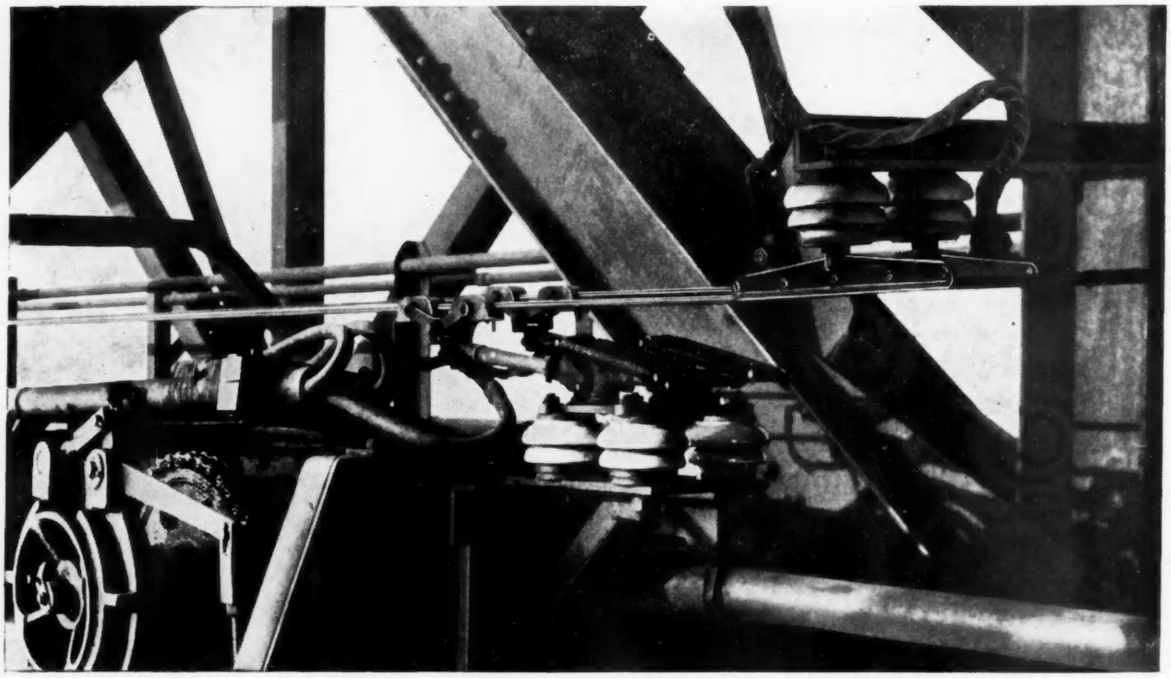
CORY BUILDINGS, FENCHURCH ST., E.C.3. 'PHONE: ROYAL 2500



Fire Prevention and Fire Fighting in Ports

A Review of British Research

By H. F. CORNICK, M.C., M.I.C.E.

THE loss by fire of the "Empress of Canada" in the Gladstone Dock, Liverpool, was one of the prominent shipping casualties of last year and served to focus attention once again upon the serious financial losses sustained by all countries due to fires.

Consideration of the cost of damage caused in recent years by fires will show the extreme importance of taking every possible precautionary measure to prevent fires occurring, and if they should break out, the necessity of extinguishing them as soon as possible. It is stated that the fire losses in 1949 in the United Kingdom amounted to over 22 million pounds sterling, and equally large figures are recorded from many countries of the world. The general increase in values is to some extent responsible for the rise in fire losses, but allowing for this, the damage and waste caused cannot be regarded with equanimity in these days when conservation of materials and increased supply of goods of all kinds is of the utmost urgency.

Docks constitute a concentration of fire risks of proportions not met with in industrial areas, large transit sheds and warehouses are often crowded in relatively small areas, containing goods of all descriptions many of a highly inflammable nature. It is only with dock fire prevention that we are concerned here, and although such fire prevention technique is not within the scope of a dock engineer's work, the author, in view of the importance of the subject, deals with all its aspects.

The necessity of preventing fires was early recognised, but it was not until comparatively recent times that fire insurance came into being and was then linked with fire fighting. With the lesson of the Fire of London before them one of the earliest Fire Insurance Companies—the Sun Fire Office in 1710—appears to have provided not only means of insurance against fires but also men and fire equipment for the purpose of extinguishing fires occurring on the property of insured members. Since that date there has been the Fire Office Committees, originally formed for the purpose of protecting the interests of the Fire Insurance Companies and Underwriters.

At the present time in the United Kingdom we have the Fire Offices Committee of the Fire Protection Association, the objects of which in general terms have been quoted by Mr. W. H. Tuckey, O.B.E., Director of the Fire Protection Association as follows:—

"(1) To advance the science of fire protection.
(2) To disseminate advice on fire protection and allied subjects.
(3) To investigate the causes and spread of fire.
(4) To publish codes of practice relating to fire protection.
(5) To collate and analyse fire statistics.
(6) To propagate knowledge in connection with fire protection.
(7) To co-operate with Government Departments and other bodies in fire protection."

In the years after the last war, two new organisations were set up, the Joint Fire Research Organisation which has inherited the Testing Station at Elstree, and the Fire Offices' Committee Fire Protection Association, before referred to. The former is a "Joint" organisation, namely, the Department of Scientific and Industrial Research, and the Fire Offices' Committee. This is a unique case of co-operation between a Government Department and an industrial concern. The reports on various investigations into building fires are published from time to time. The F.P.A. provides what is in effect, a Full Advisory Service to all and anyone may obtain advice free of charge. The very best technical aid is available in implementing this service, it is one that is widely used and in compiling some of the following notes, the author has drawn upon F.P.A. data, together with the Report of the Working Party on Fire Prevention and Fire Fighting in ships in Port, set up by the Ministry of Transport in 1948[1].

Somewhat similar organisations are in existence in certain Continental countries and in American ports; the work of the National Fire Prevention Association of Boston, Mass., appears to bear some resemblance to that of the F.O.C.F.P.A. of this country, and there is between the two associations a considerable degree of collaboration.

Besides the information and data published by the above organisations and the special services rendered by the F.P.A., mention must be made of the Manuals of Firemanship, which were originally published, in parts, in 1944 by the Home Office (Her Majesty's Government) and are now being reprinted and brought up-to-date. From time to time reports are also published on enquiries into the causes of any large conflagrations that may have occurred[2].

Causes of Fires

Dealing first with fires in ships while in port, it seems that many of them can be attributed to careless practice, such as the use of burning and welding apparatus (which statistics show to be the greatest single cause of fires) in repair work or alterations without heed to what may be on the opposite side of the plating, or to faulty temporary electric equipment. Other examples of careless practice are the indiscriminate throwing away of cigarette ends and the failure of patrolmen to exercise their duties. An analysis of causes of fires in ships in port in the U.K. during the years 1946-1948 is:—

	1946	1947	1948
Burning and welding apparatus ...	104	120	130
Smoking and matches	24	46	32
Stoves (galley and flues)	36	13	16
Electric wires, cable and equipments	16	18	22
Other causes	68	90	120
	248	287	320

In America it is said that by far the greatest number of fires in ports originate from fires started in vessels; this is probably not so in this country, nevertheless, it behoves the port authority to take heed of what the ships contain and the behaviour of those on board, particularly when as is usual practice, small repairs and alterations to the interior of vessels are carried out while lying alongside the quays.

There is no doubt that smoking gives rise to serious fire risks on board ship while in dock and while total prohibition is a counsel of perfection, which is very difficult to enforce, smoking is a menace which ought to be prohibited except in places, where, in the opinion of those responsible, there is no appreciable risk of fire.

Fires having an electrical origin are more likely to arise where ships' cables have been previously overloaded and insulation has deteriorated, and where the work of repair on electrical circuits is being carried out by men not familiar with the arrangement of the cables.

With cargo stowage in ships the port authority has no concern except where it exercises stevedoring duties, and the dock engineer is not interested in any case, nevertheless a few remarks upon various aspects of stowage of cargoes as affecting fire risks will be of general interest.

Long voyages add to the hazards of self-heating cargoes—that is cargoes in which there is slow chemical or bacteriological action producing heat and in certain circumstances, spontaneous combustion. It is possible again for some apparently quite innocent circumstance to add to this hazard, for example, thousands of bales of cotton may be safely transported across the sea whereas in one ship, bales may be carried in a precisely similar manner

Fire Prevention in Ports—*continued*

but one of them may contain some apparently harmless green vegetation or an unspent match which due to spontaneous heat may fire and ignite other bales. A certain amount of heat due to friction is possibly more or less unavoidable in a ship during rough weather and heavy seas and carelessness in stowing by a stevedore may give just the extra freedom of movement necessary to produce enough frictional heat to cause a fire at sea or in port when air reaches the cargo.

It is well known that the stowage of certain types of cargo in contact with other types causes fire by reason of chemical action between the two substances, and in general the necessary precautions are taken, in cases of more widely known reaction. There are, however, many apparently quite inocuous materials which in close proximity may be highly dangerous. For example, certain oxidising oils such as linseed coming into contact with cotton or other textile materials are subject to spontaneous combustion. Likewise oxygen producing chemicals such as chlorates and nitrates, in the neighbourhood of carbons such as sugar, may cause a highly dangerous situation from the possibility of heat generation and ultimately fire. Phosphorus, sodium and calcium carbide are highly dangerous materials requiring careful handling and stowage, the two latter being especially so in the presence of water.

Every man concerned with ship stowage or warehouse storage of any of these dangerous materials mentioned should be aware of the possibilities, for it is possible, even though their segregation is accomplished, to be not beyond the bounds of probability for small portions of one type to be spilled on containers or broken bags to be carelessly got rid of by a labourer by putting them anywhere but in the right place. Adequate inspection and supervision is always necessary.

Again, it must not be forgotten that many substances such as rubber, pitch, wax, and sulphur melt and flow when heated and must not be stowed in any situation subject to excessive heat or where they could reach other inflammable goods. Bunker fires caused by spontaneous combustion are not unknown either at sea or in port. They may be caused by mixing certain British and foreign bunker coals, a phenomenon which may not be generally known, but several fires, it has been stated, have been caused by bunkering British coal on top of a residue of foreign coal, left over from a previous voyage.

The greatest hazard of all is undoubtedly oil. This commodity, in a crude and/or refined state, is handled in bulk in special docks and oil depots, where elaborate precautions are taken both at the tanker berths, refineries, storage and distributive centres.

In commercial docks, oil will only be handled as bunker oil for fueling vessels, engines and floating plant of various descriptions, together with petrol in storage containers for distribution to the port authority's road vehicles and plant. The Fire Offices' Committee has special regulations for such installations which must be adhered to in order that the Port Authority may be fully covered by Fire Insurance.

Granaries and grain silos also constitute a considerable fire hazard principally on account of the dust generated in handling the grain, which is a matter requiring most careful attention both in the design of grain storage facilities and in the handling of grain.

Preventive Measures

A broad division of the directions in which measures can be taken to minimise the risk of fire and and general conflagration may be stated as follows:—

(a) In the construction of warehouses and transit sheds.

(b) The provision of first-aid fire fighting equipment.

(c) The supply of water under pressure.

(d) Maintenance of electrical circuits and equipment.

(e) Storage of merchandise.

(f) Fire patrols.

Construction of Warehouses and Transit Sheds.

In considering the design of buildings from a fire resistance point of view attention must be bestowed upon the following essentials:

(1) Means of escape for occupants in case of fire.

(2) Prevention of spread of fire in the building and to other buildings in the immediate vicinity.

(3) Provision of means of fighting an outbreak of fire.

(4) Use of materials which will minimise damage to the building by fire and by fire fighting.

A New York Pier after a fire.

Naturally the relative importance of these items and the stringency of the regulations governing them depends upon the use to which the building is put, its size, the number of people using it, the number of floors and its situation in respect to other buildings and its access. The Fire Offices' Committee of the F.P.A. and the Fire Grading Committee of the D.S.I.R. issued a Report entitled "Fire Grading of Buildings,"[3] which deals at length with the problem of fire resistance of buildings and makes a series of recommendations.

The grading of buildings by "fire-load" is given, i.e., by the amount of heat which can be liberated by the complete combustion of the materials normally in the building. This is expressed in B.Th.U. per square foot. A "fire-load" of less than 100,000 B.Th.U. per sq. ft. is considered low, from 100,000 to 200,000 moderate, while above 200,000 is considered high. In the report it is recommended that the elements of the structure of a building should possess a fire resistance, in hours of standard test, of one for low fire-loads, of two for moderate, and of four for high fire-loads.

According to the grading of buildings by fire-load, examples of structures of low fire-load are flats, offices, schools, hotels, canteens, public libraries, administration buildings and certain factories and workshops in which the materials and processes in use

Fire Prevention in Ports—continued

Steel-framed building after five days' exposure to fire.

are of a non-hazardous nature. Engineering repair shops and power stations would constitute a low fire-load. Buildings with a moderate fire-load include retail shops and other types of factories and workshops where special risks arise in connection with the classes of materials worked upon. A high fire-load is constituted by warehouses and other buildings used for storage in bulk of commodities of a recognised non-hazardous nature, while the highest fire-load is carried by warehouses and other buildings used for a similar purpose but containing materials of a recognised hazardous nature.

The Standards of Fire Resistance.

These are dealt with in a British Standard entitled—"British Standard Definitions for Fire Resistance, Incombustibility and Non-Inflammability of Building Materials and Structures (including methods of test)."[4] The ability of a structure to resist fire is defined in terms of the time during which it will perform its functions when subjected to the action of a serious conflagration. Thus, structures and their elements are classified into five grades, A, B, C, D and E according to their functioning satisfactorily in a fire for six, four, two, one or half-an-hour. Materials considered alone are classified separately.

The Fire Office Committee originally set up by the Insurance Companies has drawn up rules dealing with the construction of buildings, fire fighting appliances, etc., which are set out in pamphlet form[5]. While not having any statutory authority these rules

Timber framework after severe fire.

are of considerable importance in the United Kingdom because compliance with them ensures full insurance and the granting of rebates off insurance premiums.

Considering warehouses and transit sheds in docks, the basic principle of fire protection is adequate separation of the buildings one from another, secondly, the division of buildings into compartments and thirdly, provision of access to the buildings by roads, as well as the normal access by water to dock-side buildings.

In some of the older docks in many ports of the world, the spacing of and access to warehouses and sheds is not adequate by modern standards and this is particularly so where sheds occupy the whole available deck space of piers, as for example, in a majority of the piers in New York, where the fire hazard is abnormally high, for this reason. Moreover, the cross fire walls with their large doors, necessary for normal working, are very inadequate, and the materials used in construction of the piers, and in many cases the sheds, are of timber. The illustration shows such a pier after a fire, and that the only portion standing is that which was accessible to shore fire engines. It is interesting to note that as a means of localising fires in New York pier sheds* by preventing its horizontal spread, skylights situated in the apex of the roof, which open automatically when the temperature exceeds 165° F. are considered to be important. They are advocated midway between cross fire walls and as large as practicable but not less than 5-ft. by 20-ft.

In Great Britain, transit sheds are, as a rule, single storey buildings of non-inflammable material such as reinforced concrete and brick or steel framed with corrugated iron or asbestos sheeted sides and roofs. Occasionally there is an upper floor but even so the fire risk is low, for goods remain in them for relatively short periods and since there are usually people constantly in or about the sheds, supervision is easier and the surreptitious smoker is at a disadvantage.

Warehouses on the other hand are mostly multi-storied buildings in which merchandise is likely to be stored for comparatively long periods, consequently goods liable to fermentation have more chance of overheating and causing fire.

Fire Resisting Materials.

The choice of materials for fire-resisting construction is limited, the usual choice being made between concrete, brick, steel and timber. Not all timbers are equally combustible and hard woods such as teak are very slow burning and may be used in many situations. Soft woods also in heavy section often afford considerable resistance to fire, by reason of the layer of charcoal with which they become covered and which protects the timber beneath from rapid combustion.

Resistance to fire can be considerably increased by impregnation with various chemicals. With proper treatment, timber in small scantlings can be rendered non-inflammable by this means—that is to say, it will not ignite, burst into flame or glow, but merely char. In this respect, the timber so treated may have a comparatively high period of fire-resistance and will not therefore materially assist in the spread of fire.

Some protection against the initial outbreak of fire can also be provided by fire resistant paints.

There is therefore today not the same objection as heretofore to the use of timber for constructional purposes. Indeed, it can be shown[6] that, used in certain minimum scantlings, timber can be superior in some respects to metals similarly used.

Steel is a material whose strength in tension is markedly reduced through the application of heat. Under the great heat generated in a fire steel beams will sag and cause collapse. Also owing to its high thermal conductivity, the metal is very rapidly heated, thus spreading the heat throughout large portions of the steel frame. An important factor in building construction with steel, is the insulation of it from direct heat, for unless steel columns and beams are protected by a suitable fire-resisting covering, fire may bring about the total destruction of the building through collapse.

The London County Council in their Building Bye-laws contain regulations for concrete cover to steelwork, which are often

Fire Prevention in Ports—continued

taken as a guide by other areas outside London. They are, in brief, as follows:—

Columns wholly or partly in external or party walls	4-in. in all sides.
Other columns	2-in. in all sides.
Beams wholly or partly in external walls	4-in. except to underside and edges of flanges, which may be 2-in.
Other beams	2-in. except to upper surface of flange which may be 1-in.

The concrete casing should be reinforced with light wire mesh.

With regard to the use of brick and concrete in the construction of sheds and warehouses, it may be said in general that the requirements of first-class engineering work will provide an adequate fire resistant building. Solid concrete floors at least 5-in. thick are usually accepted as fire resisting, and there are many other forms of concrete floor of proprietary design, of the hollow tile and pre-cast unit type which are accepted by the L.C.C. with certain provisos and may therefore be included in fire-resisting construction.

Points of Design.

Transit sheds are usually somewhere about the length of a berth, say, 600-ft. or so; such a shed would be normally divided into two compartments by cross walls, passing through the roof. In the case of transit sheds or warehouses of two or more storeys, it is desirable for the staircases and/or lift shafts to be enclosed by walls of fire-resisting construction with the openings to the storeys protected by double fire-resisting doors.

If the fire-fighting forces know that the fire they are fighting cannot spread beyond certain limits they can then concentrate upon extinguishing it and will not have to dissipate their efforts in cutting it off from other parts of the building. In the case of multi-storied warehouses it will be obvious that if the floors are of equal fire-resistance to the walls, the chances are that the fire will be confined to one floor.

Internal door openings are naturally the weakest parts of buildings and careful attention must be bestowed upon their selection and fitting. They are usually of steel of the sliding type, or roller shutters, composite steel and asbestos doors, or other types of protected doors of special proprietary construction.

It will rarely be necessary to provide outside fire-escape stairs in dock warehouses for the number of persons employed therein is usually very small. Often it is possible to provide adequate egress to balconies where available, or to the roofs from the main staircases, which as already mentioned, should be totally enclosed and cut off from the various floors.

In laying out electric light and power circuits in warehouses and sheds, the electical engineer must always have before him the necessity of simple and safe design, the provision of adequate switching, fusing and safety arrangements, and perfect workmanship. While equally important is efficient inspection of circuits and electrical equipment and adequate maintenance.

Automatic Fire Fighting Appliances.

Sprinklers. A satisfactory form of protection for warehouses in docks where goods of a highly inflammable nature are stored is the automatic sprinkler system, and it has been recommended by the Fire Protection Association that consideration should be given to equipping a warehouse with sprinklers if the floor area of any one compartment exceeds 10,000 sq. ft., regardless of the type of goods normally stored there. Where sprinklers are installed care must be exercised to insure that the storage height of the goods does not interfere with the diffusion of the water.

There are three sprinkler systems in general use; the wet pipe, dry pipe and a combination of the wet and dry types. In the former the pipes are always full of water under pressure, the water being immediately discharged in the functioning of the automatic control due to heat action. In the dry pipe system the pipes are filled with air under sufficient pressure to hold back the water and on the functioning of the control the sprinkler head opens and relieves the air pressure on the water valve which opens and allows the water under pressure to flow into the pipes and sprinkler heads. Various sources of water supply may be employed—the fresh water mains, elevated tank, pump, hydraulic injector apparatus, etc.

There are other forms of sprinklers using agents other than water, for example, batteries of CO_2 cylinders or CH_3Br. cylinders may be used, automatically operated by a thermostat or electricon smoke detector, together with emulsion forming water jet apparatus.

Expert advice should be sought in all cases when considering the installation of sprinkler systems in any warehouse or building.

Fire Alarms. Failing an automatic sprinkler installation, an approved automatic fire alarm system signalling direct to the dock offices and the public fire brigade constitutes a valuable form of protection.

Other Fire Extinguishing Appliances. The type of appliances which should be installed in warehouses and buildings depends in the case of transit sheds and warehouses, on the nature of the goods stored. For ordinary combustible merchandise soda/acid or water (gas expelled) type extinguishers, hose reels, or water buckets kept filled with water are the most suitable. The Fire Offices' Committee of the F.P.A. recommends the following types and scales of distribution of first-aid fire extinguishing apparatus:

> Soda/acid or water (gas expelled) portable fire extinguishers with an aggregate capacity of two gallons for each 250 sq. yards of floor area but not less than four gallons per floor. Hydrants or hydraulic hose reels—one for each 500 sq. yards with at least one to each floor. Hydrant outlets should be fitted with couplings suitable for use by the public fire service, and by means of adaptors, be coupled with lengths not exceeding 60-ft. of hose, not less than $1\frac{1}{2}$-in. nor more than $1\frac{3}{4}$-in. diameter. There should be a constant water supply at a pressure sufficient to command every part of the premises. If hydraulic hose reels are fitted, the tubing should be $\frac{3}{4}$-in. to 1-in. internal diameter. Water buckets—three buckets for each 250 sq. yds. of floor area but not less than six for each floor. Foam is generally recognised as being the most efficient extinguishing medium for fires involving flammable liquids which are not mixable with water. Foam extinguishers should be installed where such liquids are stored or used and should be provided in addition to those for the general protection of the premises.

Fresh water hydrants on quaysides for ship watering are standard practice. Where there are hydraulic mains in the same culverts as the fresh water mains, the hydraulic pressure water provides a simple means of obtaining an ample supply of water at a high pressure when connected by means of special mixing valves at each fresh water hydrant.

It is desirable that the fresh water hydrants for fire-fighting purposes should be carefully planned and preferably in collaboration with the local fire brigade authority. The position of all hydrants and of all the control valves both in the fresh water and hydraulic service mains should be clearly marked on the site, moreover diagrams of the mains should be available at all branch dock offices and police control centres.

During the last war at all United Kingdom ports and docks elaborate auxiliary fire services were constituted equipped with trailer pumps and other fire fighting appliances, but few of these are in existence in any form at the present time.

Ships in Port.

While a ship is in dock, fire prevention and initial fire fighting measures are the responsibility of the ship owners, but when repair work is undertaken to a vessel while lying at her berth some dual responsibility is likely to arise between the owners and the ship repairers unless this aspect of the position is clarified by clear agreement. Fire patrols are in many instances a normal arrangement carried out by the crew of the ship when in dock and in 1945, to continue in some sort the emergency measures instituted during the war, it was suggested that the organising of port "fireguards" who will know what to do until the arrival of the fire brigade, should be given consideration. It has further been sug-

Fire Prevention in Ports—continued

gested that Port Authorities and Fire Departments should integrate and share fire prevention work by jointly establishing emergency fire forces composed of personnel trained in the use of emergency fire equipment, somewhat on the lines of the early volunteer fire brigades.

The findings of the Ministry of Transport Court of Enquiry into the loss of the "Empress of Canada" by fire were reported in the March issue of the "Dock and Harbour Authority." The most likely cause of the fire was ascribed to clandestine smoking, probably an unextinguished cigarette end having been left in a cabin.

Other findings included: no liaison between owners and fire brigade, fire patrol frequency below the recommended standard, dock patrols operated only at night, no direct telephone line from ship to fire brigade available, the fire mains were uncharged, fire doors and watertight doors were not closed.

Fire prevention and fire fighting in a ship at sea are matters to which considerable and apparently adequate attention has been given. While a ship is in dock, however, the matter becomes one of more complexity and seems to require even greater consideration, due to the greatly altered circumstances.

Apart from the possible loss of the ship, the dock property and plant together with the merchandise housed in sheds are also placed in hazard by a ship fire. The problem of fire prevention in ships in port can only be adequately solved by complete collaboration between all the interests concerned.

* Articles on "The Pier Fire Problem" and "Fire Protection at the Port of New York" appeared in the July, 1949, and October, 1953, issues of this Journal.

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St. Anthony Falls Hydraulic Laboratory, Minneapolis

Natural Water Power for Research Experiments

By DR. LORENZ G. STRAUB, Director

THE St. Anthony Falls Hydraulic Laboratory, now passing the fifteenth year since its dedication, has developed into an active co-operative research enterprise of the University of Minnesota. The St. Anthony Falls, on the Mississippi River itself, was basic in the establishment and growth of the Twin Cities of Minneapolis and St. Paul, now situated at the head of navigation on the Mississippi, the largest of North American rivers. The laboratory site was in nature an island known as Hennepin Island, dividing the falls into two sections, and named after a Belgian friar who, with a party of French explorers, discovered the Falls in 1680 and christened them the "Falls of St. Anthony of Padua."

One of the early saw mills on the Mississippi River was situated at this identical spot, and the water rights attached to the property are the earliest known in this area, having been first utilised to furnish power for the saw mill. The rights were later acquired by the City of Minneapolis and these rights, together with the water site, were later made available to the University by State legislative enactments and actions of the City of Minneapolis for the construction of the Laboratory, while labour for the building operations was provided by the Federal Works Projects Administration.

In its basic features, the Laboratory is designed to operate almost entirely by use of water diverted from the Mississippi River above the Falls. The water passes through the plant by gravity and is returned to the river after serving its purpose at various experimental levels below the headwater pool. The natural drop available is 50 feet, with provision for close control of both headwater and tailwater levels. The water rights make possible a minimum flow of 40 cusecs at all times, and the Laboratory is designed to handle for experimental purposes rates of flow in excess of 300 cusecs. Flows up to this amount can be accurately measured by huge volumetric basins situated at the downstream end of the Laboratory just above the lower pool. All the principal features of the Laboratory had been tested by means of small-scale models in the establishment of the final design, including, for example, the mechanisation of the twin volumetric measuring tanks. This policy continues to be followed in the progressive further development of the plant.

Close head control on the upper pool of the Falls is given by a weir approximately 2,600 feet long, thus providing what amounts to a huge constant-level tank for the Laboratory. About a thousand feet downstream of the Laboratory the tailwater pool is controlled by a gated and overflow spillway, so that the water level downstream is also very closely controlled with only a foot or two variation in level between the conditions of low-water and high-water flows of the Mississippi River.

Supplementing this major system of operation are numerous independent recirculating units, so that fluids other than river water (including kerosene and other more viscous fluids, and also air) can be used as the flowing medium.

The Laboratory structure itself was literally carved from the limestone ledge forming the Falls and the stone island on which it is situated. Much of the superstructure was built from the limestone quarried from the site and supplemented by reinforced concrete.

Fig. 1. View of the St. Anthony Falls Hydraulic Laboratory on the Mississippi River from below the Falls.

St. Anthony Falls Hydraulic Laboratory, Minneapolis—continued

The principal functions of the Laboratory are:

(1) Instruction and training of students and graduates in hydraulics and fluid mechanics.

(2) Fundamental research in a broad field of fluid mechanics.

(3) Applied research involving largely the experimental design and analysis of specific hydraulic structures.

Apart from the special features of water supply and the volumetric measuring tanks mentioned above, the equipment of the Laboratory follows modern practice in providing facilities for fundamental research and for scale model experiments. It is not feasible to give a full description of all the facilities for reasons of space, but the following items may be mentioned.

(1) An intake control house containing large electrically operated gates to control the flow from the river, together with propeller pumps and booster units for increasing the head above that provided by the Falls.

(2) A contracted flume section with a streamline entrance for establishing high velocity flows with a uniform velocity distribution.

(3) Recirculating systems, independent of the main supply, for more accurate control of the physical properties of the fluid when needed.

(4) A main test channel, for open flow experiments, length 300-ft., breadth 9 feet and depth 6 feet.

(5) A sediment channel for sediment transportation studies equipped with recirculation pumps, heating and refrigeration, for studying the effect of varying temperature and viscosity.

Fig. 2. Aerial View of St. Anthony Falls on the Mississippi River in the Heart of Minneapolis showing the Hydraulic Laboratory situated on Hennepin Island in the centre of the river on the brink of the Falls. There is a 50-ft. drop in the Mississippi River at this location.

(6) Two glass-sided wave research channels.

(7) A vertical gravity flow free jet water tunnel of unique design, producing an 8-inch test jet similar to the stream from a nozzle flowing through an air vacuum chamber. Exceptionally low cavitation values can thus be obtained in the jet of water flowing past inserted models.

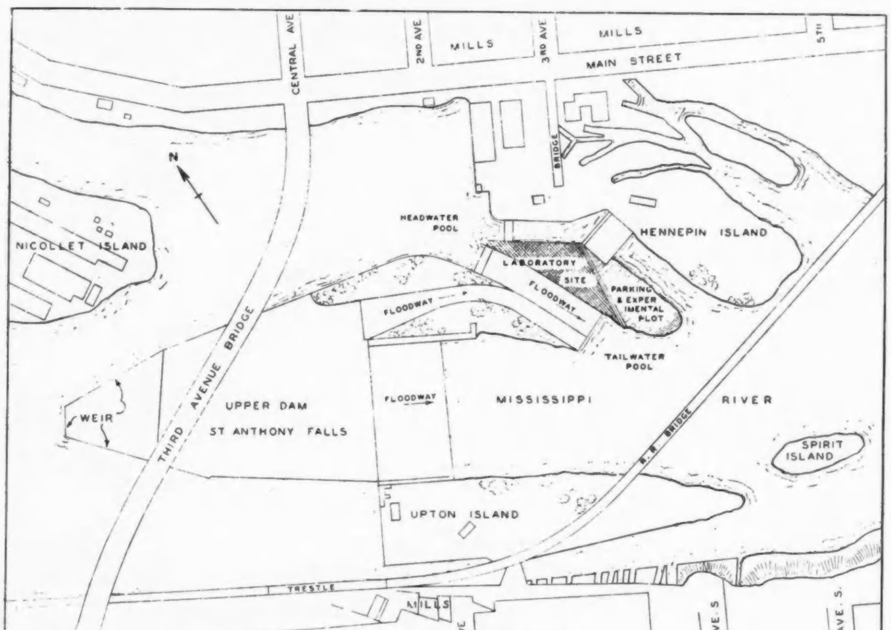
(8) Two pneumatically controlled discharge weighing tanks, capable of measuring discharges from any of the laboratories up to 5,000 gallons per minute.

A full range of ancillary equipment is housed in other parts of the building, including mechanical and electrical workshops, model shops, lecture theatres, and accommodation for staff.

At present the experimental studies and general research programme are especially diversified. Experimental studies are in progress on a number of river and spillway models for projects in various places in the United States. Basic experiments have been under way for some time on high lift navigation locks. A variety of studies are being made of various types of culvert entrances and types of conduits; these have been made to small-scale and on sizes up to 3 feet diameter and 200 feet long, involving corrugated iron as well as concrete types.

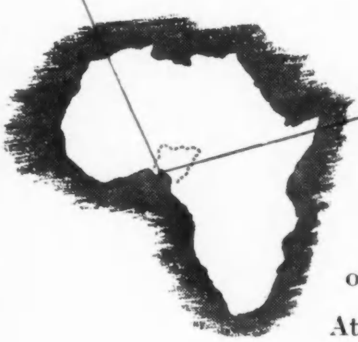
Recently full scale studies have been made of articulated revetments being used to stabilize the banks of the lower Mississippi River. Studies on sediment aggradation and degradation are in progress in the various special channels provided therefore. Suspended sediment as well as bed sediment transported are being studied under various temperatures and corresponding fluid viscosities. Research of the mechanism of insufflation and entrainment of air by water flowing at high velocities is being actively carried on at present.

Other studies in progress include experimental research in hydrofoils, surface waves, density currents, mechanics of flow of mixed fluids, stability of coastal engineering structures, and the like. Most of the research is sponsored by various agencies. Although the programme is entirely under the supervision and guidance of full-time staff members, graduate students specialising in hydraulics and fluid mechanics assist with many phases of the work on a part-time basis, supplementing their graduate study and providing a stipend for part of their financial support.



Site Plan of St. Anthony Falls Laboratory.

Apapa goes on the map



A new town named Apapa now stands where once there was only a mangrove swamp. At Lagos, Nigeria, British West Africa, the Westminster Dredging Company played a prominent part in the transformation by reclaiming an area of 750 acres of unproductive marshland. On the site they prepared, modern housing schemes for both Africans and Europeans are fast taking shape. To speed operations, an all-electric prefabricated ground suction dredger was assembled on the spot and used in clearing adjacent creeks, dredging a new canal to a width of 200 feet and pumping approximately 5,000,000 cubic yards of sand to the site. The entire reclamation scheme was undertaken by contract with the Lagos Executive Development Board arranged by the Crown Agents for the Colonies.

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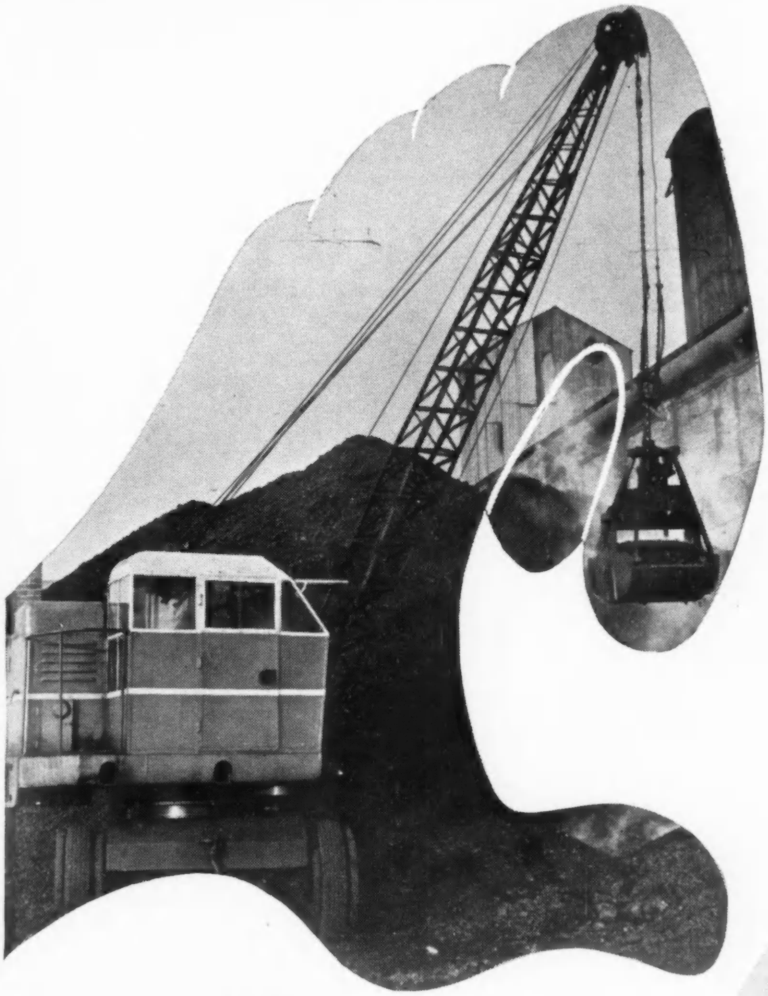

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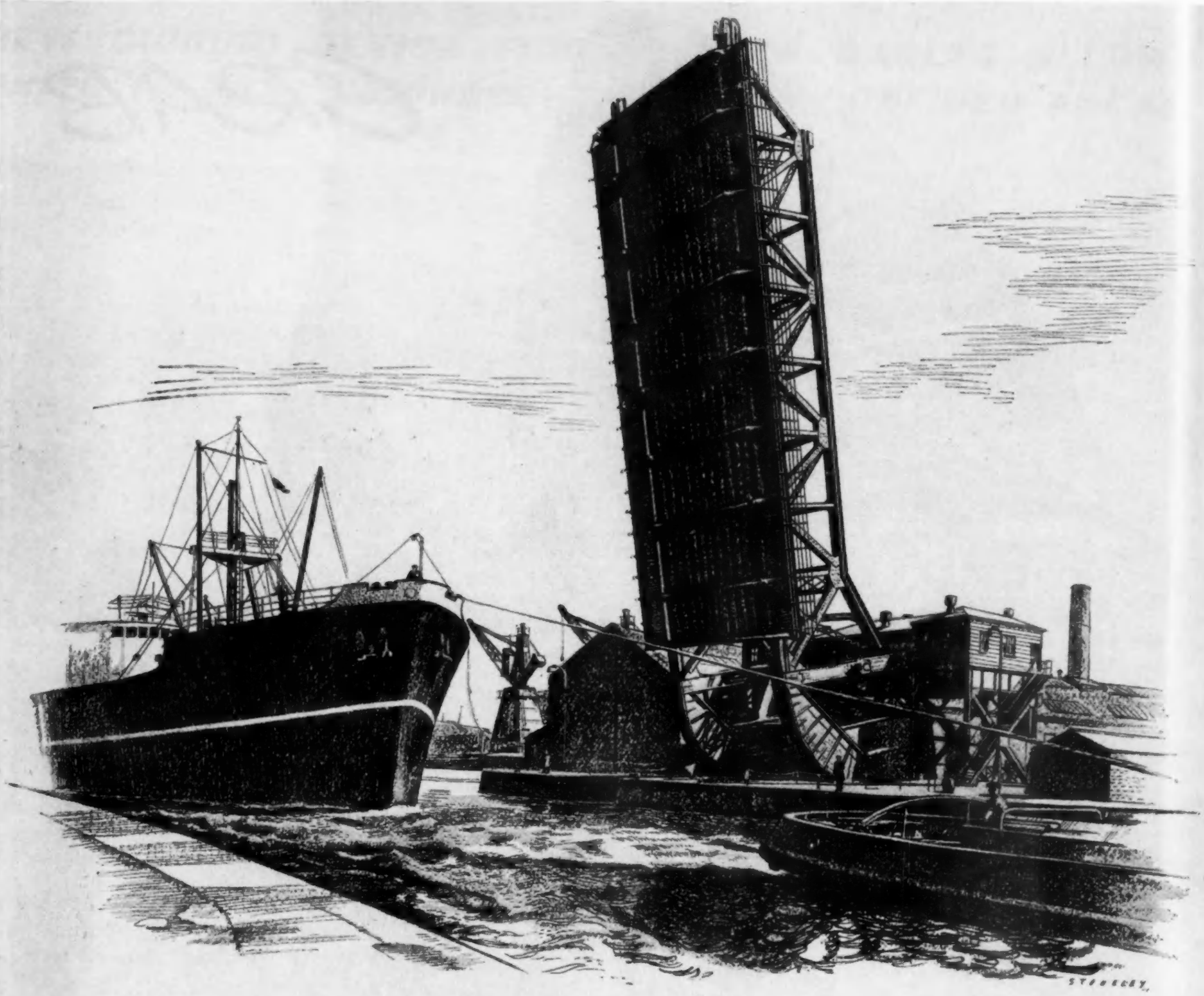


St. Clement's Bridge, Aberdeen

The "Anderson" Heel Trunnion Bascule Bridge

(Specially Contributed)

ENGINEERING history was made at Aberdeen recently by an important step forward in docks engineering technique when, on opening the St. Clement's Bridge, H.M. Queen Elizabeth the Queen Mother put the Royal Seal on a highly successful departure from orthodox practice in this country, and we believe in the world, in regard to movable bridges.

Realms of dock engineering are not everybody's territory and the work of the docks' engineer has many interesting specialised facets which do not ordinarily impress the minds of laymen and to some considerable extent it may be true that the general engineer is relatively unfamiliar with the problems which the docks' engineer has to face, most of these problems having special relation to navigable waterways, to the traffic of cargo and passenger shipping and to the unpredictable moods of the open sea in proximity to harbour waterways. Construction of large shipping docks with the provision of various port facilities calls for the application of engineering skill in many unusual problems often calling for the exercise of originality and ingenuity as well as patience and courage.

Dock gates or caissons; graving docks or floating docks; tidal quays or wet docks; dredging or training works; lockways or tidal dock entrances; cranes or conveyor equipment; rail or road facilities; lifting or swing bridges—these are some of the special alternatives to be met with and the pros and cons considered by the docks' engineer. They all have features peculiar to port undertakings and accordingly although serving the needs of civilisation as a whole, they may not always be readily understood by the man in the street nor their technical significance appreciated. The

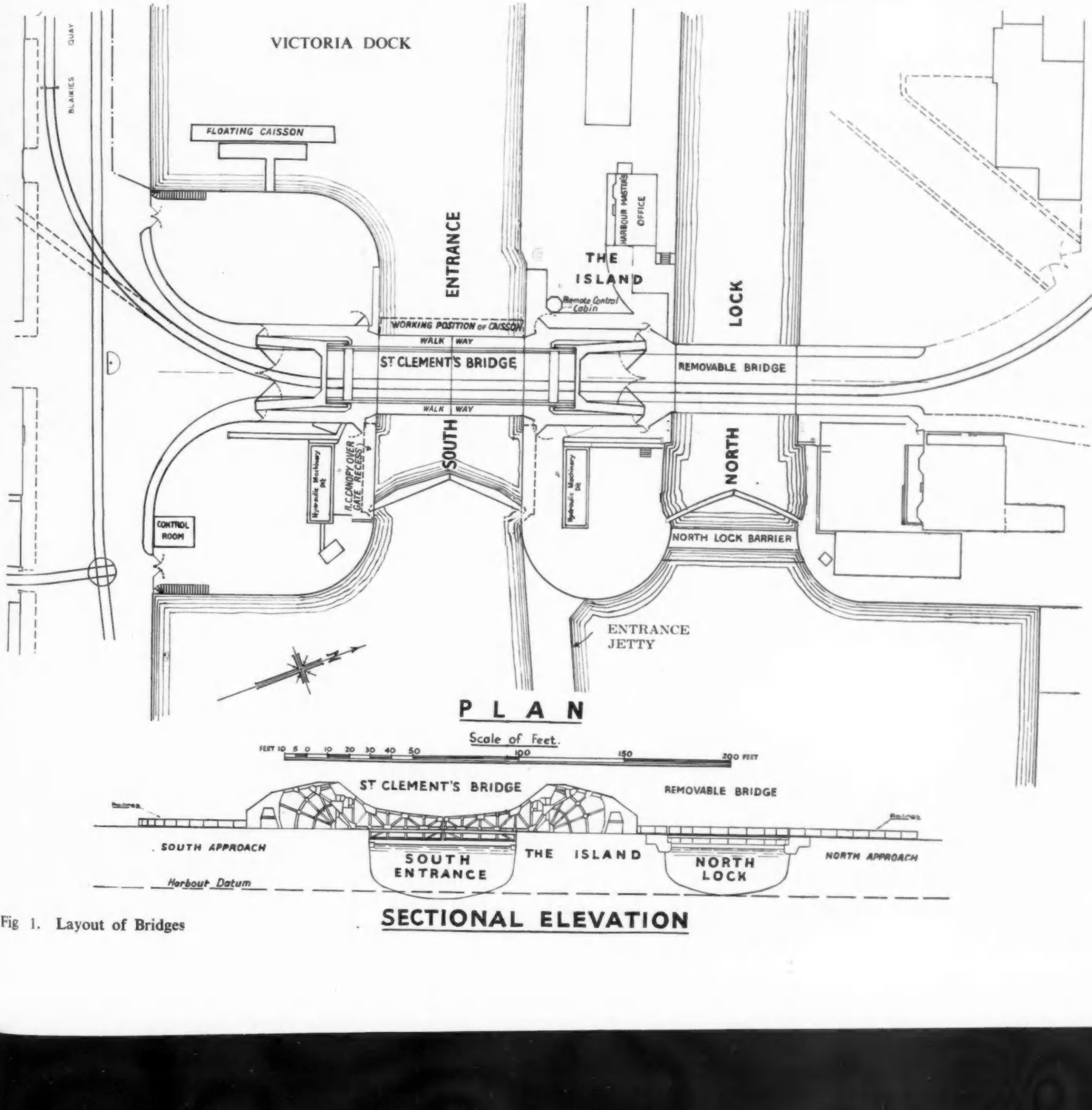


Fig 1. Layout of Bridges

St. Clement's Bridge, Aberdeen—continued

present article deals with one of the most fascinating features of navigable waterways—the movable bridge with its appeal variously to the creative imagination of engineers and bridge builders, the constructive impulses of boys and men or to the nostalgic sentiments of those who sail the seas.

At Aberdeen there are on a small scale many of the installations named and we have recorded in previous issues of this Journal various new works of engineering and technical interest which have been carried out within the past ten years, including the replacement of timber dock gates by all-welded steel units involving the installation of a supplementary floating caisson unit used for closing the entrance to the docks when the change-over of the gates was under way; the provision of a large new coaling installation for the bunkering of trawlers and commercial vessels; construction of a deep water berth in tidal water served by a two-storey reinforced concrete shed, electric portal cranes and quay side rail track.

Various other projected improvements from the Engineer's Report of 1943 were recorded in this Journal in 1944, including the provision of sea defence extensions and new bridges.

Fig. 2. View along the Bridge taken after the Opening Ceremony by H.M. Queen Elizabeth the Queen Mother.

This article is particularly concerned with the new bascule bridge, spanning the entrance to the docks, recently completed by Messrs. Head Wrightson Aluminium Ltd. and subsidiary Company of Messrs. Head Wrightson & Co., Ltd., Thornaby-on-Tees, and subsequently opened and named by H.M. Queen Elizabeth The Queen Mother on the 30th September last (Fig. 2).

The bridge is one of two required to replace small wooden single track swing bridges erected over the two entrances to the docks which were built in 1844 by the engineer, James Abernethy, a Past President of the Institution of Civil Engineers.

The layout of the original entrances to Victoria Dock (Fig. 1) took the form of a simple tidal passage closed by one pair of dock gates, and a lockway regulated by three pairs of gates. The latter having been out of service as a lockway for the past 40 years, the seaward end of it is now closed by a permanent concrete dam and there is accordingly only one entrance to the docks at Aberdeen closed by one pair of gates. To provide alternative closure in case of gate failure, there is now also a caisson berthed nearby ready to be offered up to prepared clapping faces.

It will be seen, therefore, that the need of maintaining unbroken the service of this passage for shipping was of paramount importance to Aberdeen and the design of new works in the vicinity of the Entrance called for careful consideration, not only to achieve the desired operational functions satisfactorily, but also to avoid during construction, any encroachment of temporary structures into the waterway and to obviate the risk of damage either to shipping, to the entrance itself, or to the dock gates which are in the immediate vicinity.

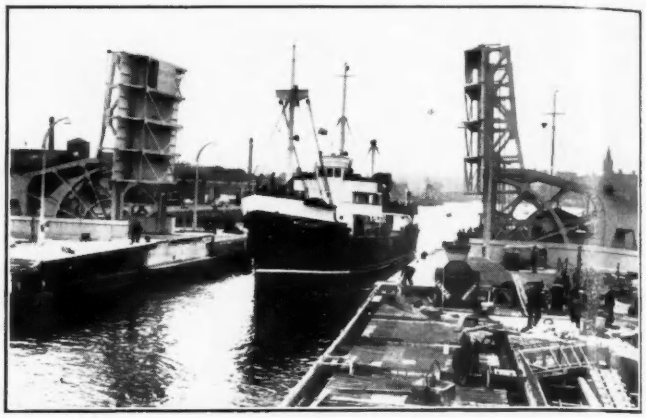


Fig. 3. View of bridge fully open taken from the East.

Consideration of the various types of movable bridge to suit the site also aimed at avoiding, if possible, any undue structural interference with the existing walls of the passage and their foundations and reducing to a minimum the concentration of heavy loadings which normally obtain with all orthodox types. Reasons of economy, and the need for continued operation of the passage for shipping entering the docks, were in this case complementary.

Limitations of site confined the bridge structure to narrow areas bounded on the one side by existing dock gate machinery and on the other by the positioning of the floating caisson already mentioned, if and when need should arise for its use.

Swing bridge, Scherzer or rolling lift bridge, or orthodox bascule bridge, all seemed to introduce undue difficulties in these respects if the work of providing a modern double track bridge in place of an old-fashioned single track bridge in the restricted space available was to be undertaken without serious disturbance, etc.

The bridge provided, however, eminently suits the requirements in regard to the various aspects enumerated; loading, location and freedom from interference of the passage during construction. Essentially unorthodox in its conception, yet simple and attractive, it has been described as a Heel Trunnion Bascule Bridge by the engineer, Mr. John Anderson, M.I.C.E., M.I.Struct.E., M.Inst.T., who has patented the design. Although suitable for single leaf application, this particular bridge has been designed as a double leaf bridge and from a study of Figs. 3 and 4 it may be conceded that the resulting appearance is pleasing. It may well be that this novel type of bridge will prove to be the solution to many similar problems, becoming increasingly familiar with the passage of time, in which existing older type bridges require to be replaced to suit modern traffic requirements.

The main features of St. Clement's Bridge, are the adoption of special balancing arrangements, the installation of the machinery inside the portal structure which moves with the leaf, the separation of the counterweight loads from the leaf itself, resulting in

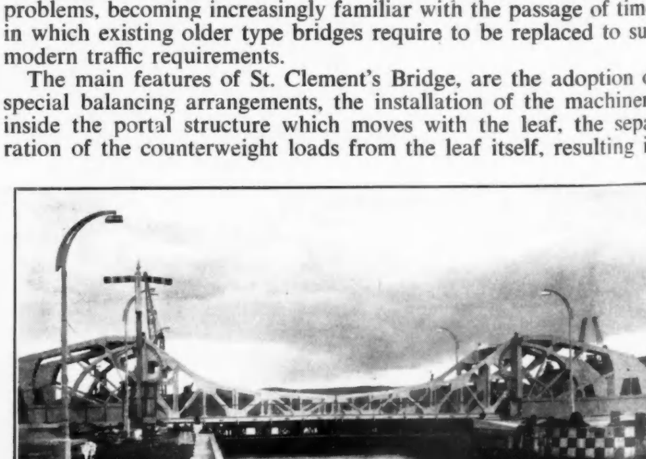


Fig. 4. View of bridge closed taken from the West.

St. Clement's Bridge, Aberdeen—continued

more satisfactory distribution of the total loads and finally, the adoption of aluminium alloy construction for the moving parts, the fixed portion being of steel construction.

The whole structure is erected above ground level and, with the exception of small pits to accommodate the vertical travel of the counterweights and the stop arm of the bridge leaf embodied in the concrete foundations, there is nothing below ground level.

The trunnions of the bridge are set back from the quay 15-ft. so that when the bridge is fully open there is a clear 7-ft. between the line of the cope and closest part of the structure at the nose. There is an unbroken quay the whole length of the passage along which operators can safely move on their various duties handling ropes or fenders for vessels passing through the entrance, an advantage previously held by the rolling lift type of bridge only.

The bridge is operated electrically by direct motor drives through fluid couplings, operating the pinions which travel along rack quadrants. There are two motors on each leaf to work together or in opposition so that the normal speed can be reduced to creeping speed. This is an interesting application of the famous Vulcan Sinclair Fluidrive Couplings which simplifies the operation of the bridge and permits of direct-on starting for the motors.

The balancing of the moving leaves is achieved by the transmission over large pulleys of a counterweight pull through steel cables passing over specially designed cams fixed to the moving structure, so arranged that the changing torque due to the moving C.G. of the leaf is compensated for.

This introduction of a cam for such a purpose permits the choice of a variety of counter-balance characteristics not available for exploitation in the orthodox types, it being possible to design the cam (1) to give perfect balance over the whole travel or (2) to introduce preponderance as desired at the limit of closing and opening travel, or (3) to change from negative to positive preponderance during the travel.

This separation of the counterweight from the bridge leaf greatly simplifies the solution of problems of foundation design arising out of the usual heavy load concentrations and provides a new line of approach to such problems which engineers concerned with similar bridges will readily appreciate and doubtless apply in due course. It will be apprehended that this method of counterbalancing provides considerable latitude in the design of bridges, not available in the orthodox types whose balance is largely based upon the relative values of the C.G.'s of the leaf and of the tail weight creating opposing torques which normally bear the same ratio to each other through the travel.

The resultant economies effected may be considerable. Machinery and power units can be simplified to suit the greater control of out-of-balance conditions. No special measures need be taken to absorb energy of out-of-balance momentum such as buffers or shock absorbers since the cam shape may be designed to convert a downward preponderance in travelling to an upward or negative preponderance in coming to rest or vice versa.

Although this first example of such a bridge does not take full advantage of all these potentialities, it does control the magnitude of negative and positive preponderances in such a way that the bridge is substantially in balance under normal conditions throughout most of its travel and is, therefore, self-sustaining without braking and comes to rest with a slight negative torque when fully open and positive torque when closed.

Each leaf of the bridge can be operated by one 10 h.p. motor for normal speeds, but for satisfactory operation against winds and positive control of creeping speed a second 13½ h.p. motor is used in conjunction with the 10 h.p. motor. Each motor drives through hydraulic couplings so that it can operate singly, together with, or in opposition to the other and this novel arrangement greatly simplifies the whole operation of the bridge which is set in motion by the turn of a single switch. The consumption of current is very small.

The use of aluminium alloy for the structural members of the moving part of the bridge is a natural development in the technical exploitation of the special characteristics of this new medium-resistance to corrosion and lightness. The strength/weight ratio of aluminium alloy has advantages which are reflected not only in the conservation of foundation loadings, but also in the whole of the machinery and balancing mechanisms, including, of course, the amount of counterweight required, resulting in reasonably competitive comparison with the use of less costly steelwork.

Whilst not essential to its success, the adoption of aluminium alloy for this new type of bridge at a time when steel was in short supply, appears to be very opportune and is a happy augury of substantial structural work being carried out over many fields in days to come and its use in this particular instance has resulted in many important developments by Messrs. Head Wrightson which will contribute to improving technique in its application to structural problems. (It may be recalled that in 1948 the company built the first aluminium alloy bascule bridge in the world, at the entrance to the Hendon Docks, Sunderland.)

The following technical notes may be of interest:—

Structural Details.

The bridge is a double-leaf trunnion-mounted bascule type designed to carry both road and rail traffic; a 22-ft. roadway has

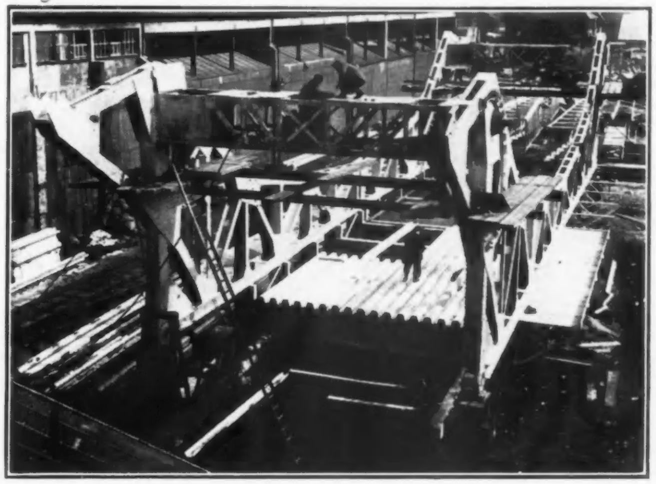


Fig. 5. Shop assembly of bridge structure.

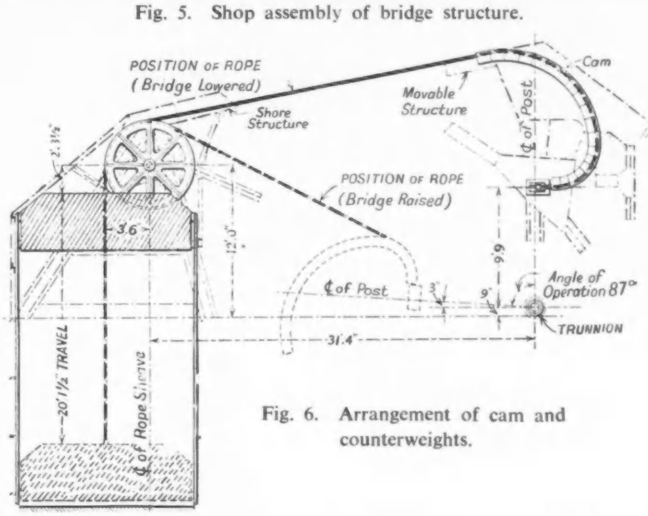


Fig. 6. Arrangement of cam and counterweights.

been provided between the trusses, with walkways 5-ft. wide outside the trusses to cope with peak-hour pedestrian traffic. The principal dimensions of the bridge are: clear opening to the dock, 70-ft.; span between the centre-lines of the trunnions, 100-ft.; length of moving span, 69-ft. 11½-in.; approximate overall length of the bridge, 198-ft.; longitudinal camber of the bridge, 4½-in. between trunnion centres; clear height under the machinery portal (limiting clearance for traffic), 16-ft.; angle of opening of the bridge, 87°; overall width, 37-ft. 1-in.; and centre to centre of the trusses of the moving spans, 25-ft. The total weight of aluminium alloy used in the movable spans is 48 tons. A shop assembly of the bridge girders is shown in Fig. 5.

St. Clement's Bridge, Aberdeen—continued

The flooring system is of cross-girders supporting troughing, the wells of which have been left unfilled. Across the tops of the troughs and bolted down are underlay timbers of Rhodesian teak, which are 3-in. thick, tongued and grooved and laid diagonally. The rails, set at standard gauge and crossing the bridge towards one side, have been bolted through the teak underlay to the tops of the troughing. The road surfacing of the bridge is made up to the level of the heads of the rails by dowelled paving blocks of Douglas fir, $5\frac{1}{4}$-in. thick, coach-screwed to the teak underlay. In all, about $25\frac{1}{2}$ tons of timber have been used in the bridge deck; it was supplied, prepared, shipped to the site and laid by Acme Flooring and Paving Company (1904), Limited, River Road, Barking, Essex.

The maximum load for which the bridge is designed is that specified in B.S.153, for a highway load of 15 units plus an allowance of 50 per cent. for impact, together with a rail load consisting of an "Austerity"-type shunting locomotive having an all-up weight of 48 tons 3 cwt. 3 qr., followed by a train with 16-ton axle loads at 12-ft. 6-in. centres, with an impact allowance of 20 per cent. The allowed footway loading is 84 lb. per square foot. The bridge has been designed and tested for two lanes of road traffic and/or one line of road traffic and one line of rail vehicles.

socket, which allows for adjustment of the rope. Each balance box weighs approximately 24 tons, the weight being made up of cast-iron blocks bedded in lead. The cams have been so shaped that the lever arm of the counterbalance pull is varied so that the leaves are underbalanced when in the lowered position, just balanced when they are being raised or lowered, and overbalanced to give greater stability, when in the raised position. There are two counterbalance weights to each leaf, one to each truss, and rising and falling in pits at the rear of the mass-concrete foundations. Above the pits, steel A-frames (part of the shore structure, described on the next page) carry 7-ft. diameter pulley wheels over which the counterbalance-weight ropes pass, to be redirected on to the cam.

Operating Machinery.

All the operating machinery is housed within the aluminium-alloy portal girder, about 5-ft. square, which forms part of the moving-leaf structure. When the bridge is fully open, the portal girders form a barricade against any road or rail traffic which may have over-run the outer gates. The machinery, for raising and lowering the leaves, operates on the twin "Fluidrive" system; the arrangement of the equipment is shown in (half-plan) (Fig. 7). The power is provided by two electric motors of $13\frac{1}{3}$ h.p. and

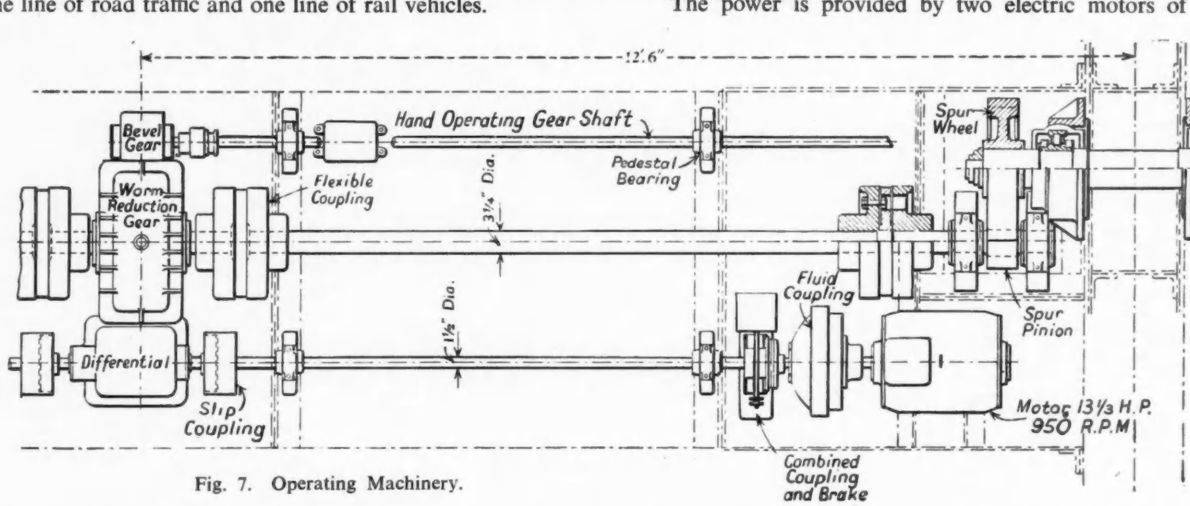


Fig. 7. Operating Machinery.

The aluminium-alloy plates and extruded sections for the bridge were supplied by the British Aluminium Company, Limited, London, and by the Northern Aluminium Company, Limited, Banbury. Two types of alloy were used: an aluminium-copper-manganese-magnesium alloy for the flooring system and an aluminium-magnesium-silicon alloy for the main trusses and the portal structure containing the operating machinery. These two sets of alloys are specified in B.S.1470, where details are given of their mechanical properties. To ensure maximum protection against the acid-bearing teak underlay, the whole of the flooring system has been metal-sprayed with a 99.5 per cent. pure aluminium. During both fabrication and erection of the bridge, precautions were taken to insulate all dissimilar metals to prevent any possible electrolytic action between them.

A notable feature was the successful cold driving of large aluminium-alloy rivets of up to $\frac{7}{8}$-in. diameter, both in the shops and at site. These rivets had special recessed shanks to facilitate up-setting. For site work, and where adequate holding proved impossible, use was made of a grummet or ring which was placed over the tail of the rivet, so reducing the amount of distortion required to complete the riveting. Test pieces from rivets driven on the site were subsequently tested at the University of Aberdeen with highly satisfactory results.

Method of Counterbalance.

The dead weight of each moving leaf is counterbalanced by a fixed weight contained in a welded steel box hanging from a locked-coil rope of $1\frac{3}{4}$-in. diameter, which passes over a special cam bolted to the main truss of the moving leaf; the arrangement is shown in Fig. 6. The rope has been anchored to the trusses by a special

10 h.p. respectively, supplied by the Lancashire Dynamo and Crypto Company, Limited. These two motors have been wound so that they develop equal torques and they therefore run at speeds which are in the ratio of four to three. The current for the motors is carried in cables running inside the bridge framing and leading on to the moving leaf at the trunnions where movements are relatively small. Both the motors, which are on a common centre-line, drive through fluid couplings, made by the Fluidrive Engineering Company, Limited, Isleworth, on to the two sides of a common differential. When the leaves begin to move from rest the drive is provided initially by only the larger of the two motors; very quickly the second motor is brought into operation, driving in the same direction as the first, so that the speed of motion is increased in the ratio from four to seven. As the leaves approach within 3° of the end of their travel, the second motor is first cut-out, stopped and then reversed; thus, the output drive from the differential is then due to the difference in speed between the two motors, that is, one-seventh of the maximum speed. In this way, the momentum of the leaves is reduced to minimise the danger of impact should the mechanism over-run. In the event of a failure, either motor is capable of moving the bridge.

From the differential, the drive is passed through a worm gear which reduces the speed by thirty to one. From the wormwheel the drive is carried outwards to the sides of the bridge and through a simple spur reduction to the driving pinions mounted outside the main trusses. The driving pinions mesh with steel pin-type rack quadrants fixed to the shore structure; the racks consist of 78 steel pins accurately mounted on a curved plate to give an effective pitch radius of 19-ft.

St. Clement's Bridge, Aberdeen—continued

All the gearing, the differential, the worm-gear and spur-gear reduction units together with the working pinions were made by Crofts (Engineers), Limited, Bradford. The pinions are supported in bearings manufactured by Cooper Roller Bearings Company Limited, King's Lynn.

If necessary—for example, in the case of a power failure—the power drive can be broken, and the bridge hand-operated; raising or lowering each leaf would then take about one hour.

The Shore Structures.

On each bank there is a fixed shore structure of steel. To the rear of each of these structures are the A-frames which support the counter-balance-weight pulleys. The middle section of the structure provides a framing which carries the rack quadrant of the operating machinery. The front of the shore structure is a portal frame (Fig. 1) the top of which is tied back through the structure framing to the rear of the bridge. The top cross girder of the portal forms a "stop" beam providing a reaction which, with the reaction at the trunnion, produces equilibrium with the live loads. The horizontal reaction at the stop beam is carried by buffers which receive the thrust from pads at the top of the rear posts of the leaf trusses. Thus, a consideration of the forces involved shows that, at the trunnion, there are vertical and horizontal reactions due to both the dead and the live loads and that the active horizontal thrust is directed into the mass of the quay wall. The second set of forces, required to complete the reaction couples, are provided by the counter-balance weight, which opposes the dead load only, and the holding-down bolts at the rear of the shore structures balancing the live load. Thus it has been possible to minimise the loads and stresses imposed on the front of the quay wall.

Control Mechanism.

The bridge operator may control the bridge from either the control house on the south approach to the bridge, or from a remote-control panel located on the other side of the dock entrance. The electrical equipment has been so arranged that the bridge is controlled from a master-drum controller and successive movements are introduced, once the mechanism has been set in motion, by a system of limit switches and operating relays. Luminous indicators show the position of the bridge leaves, and interlocks ensure that the electrical operation is foolproof. Navigation lights for shipping and traffic lights for road and rail vehicles protect the bridge from damage.

Centre-Lock Machinery.

When in the down position, the leaves are locked to each other by two steel bolts which ensure that the leaves deflect together as a load passes over the bridge. The bolts are driven home by a motor mounted under one leaf; the motor, together with the transmission gears, have been so fixed that they may be removed *en bloc* from their working position for maintenance or replacement with the minimum of interference to the bridge. This motor is operated from the master-drum controller through a limit switch actuated when the leaves mate.

Erection and Construction.

The preparation of the quay walls and of the foundations for the bridges, together with some other local extension of the quay walls, was undertaken by William Tawse, Limited, Aberdeen. The steel shore structures were put into position first and subsequently the moving spans were erected in 90 days. The lightness of the aluminium sections allowed large sub-assemblies to be shipped directly to site and heavy cranes were not required for erection purposes. The erection of the bridge and its foundations presented no special problems and there was no interference with the continued use of the passage by shipping.

Welfare among British Dock Workers

Development of Comprehensive Policy*

By F. G. THOMAS, M.A.
(Chief Welfare Officer, National Dock Labour Board).

The present Dock Labour Scheme came into operation in the ports of Great Britain in July, 1947. The Scheme, which derives its authority from the Dock Workers (Regulation of Employment) Act, 1946, requires the National Dock Labour Board to make "satisfactory provision for the training and welfare of dock workers, including port medical services, in so far as such provision does not exist apart from the Scheme ".

War-time Activities.

During the war, there were temporary Dock Labour Schemes designed to man the ports with a labour force of dock workers, which had been depleted by the call-up of men up to thirty-seven years of age for the armed forces. To use this limited labour force to the full, men were transferred from one port to another and there lodged in hostels or private houses. During that time Welfare Officers were appointed to deal primarily with these arrangements and other special war-time problems.

Much was done during the war that was important—though it was directed to the war effort. At the beginning of the war, there were only two covered call stands for dock workers in all the ports of Great Britain; during the war many semi-permanent call stands were built. At the same time, because of rationing and the need to feed men on transfer, the Government urged port authorities to build canteens on the docks. And in spite of blackouts and bombing, dock workers, being very sociable beings, whether on transfer or at home, whether blitzed or standing by, created their own social welfare activities, which ranged from flower shows in the call stand to plays written, produced and acted by dockers. These efforts were spasmodic and sporadic, yet gave birth to the very considerable welfare activities which are now to be found in the ports included in the present Dock Labour Scheme.

Tradition of Self-Help.

It would be wrong to assume, however, that welfare among dock workers did not exist before the war. There were always closely knit groups among the workers who looked primarily to the dock industry for their livelihood. Around this core of real dock workers, there was a large, floating, nondescript population of other workers who drifted around the docks; they did not belong—they had no stake in the industry. But among the inner circle of men, there was often to be found benevolent welfare activities, sometimes arising from the personal relationship of man and employer, but more often based on group loyalty and taking the form of looking after " one of us " who may have had some misfortune. In the hard days, when many unions were local organisations, when the docker lived near and belonged to the waterfront, this loyalty was deep-rooted in family sentiment and very practical in its application. The docker's widow, the man in difficulties with the law, the man threatened with the bailiff—these were the focal points of welfare from the men, who did what they could from their own strength to help those in need. Their loyalty to the union often withstood the acid test of deprivation at home.

This was the foundation of trade unionism among dock workers and its continuing strength—for they were generous to an extraordinary degree and loyal to the limit of self sacrifice. They responded very readily to a great idea.

For example, in 1896, when Tillett had just founded his union, the Executive sent an emissary to America with some 1,500 dollars of their very limited funds to start a Longshoremen's Union in New York because, with Tom Mann, they had visions of a world-wide international union of men of the waterfront.

In reviewing modern developments of welfare, it is important to remember this historical background; modern welfare among dock workers must harness this tradition.

The Dock Labour Board's Inheritance.

When the National Dock Labour Board took over in 1947, it therefore inherited a social legacy of no little significance. It also

* Reprinted from the February, 1954, issue of the International Transport Workers' Journal.

Welfare among British Dock Workers—continued

inherited from the wartime Dock Labour Scheme some very practical assets. Some call stands had been built; in Glasgow and Liverpool a port medical service for dock workers had been established with eleven medical centres and, near Manchester, a Rehabilitation Centre had been set up; the beginnings of a personal welfare service had been launched through the appointment of welfare officers. These were the beginnings of welfare, which were localised, varied and without shape or form.

At the same time, the Board also inherited an element of distrust—that there was "some catch in it", that the Board's activities in welfare were not disinterested, that the dockers' traditional, if unreal, freedom was threatened. It is against this background that any narrative of welfare development among and with dock workers of the United Kingdom must be set.

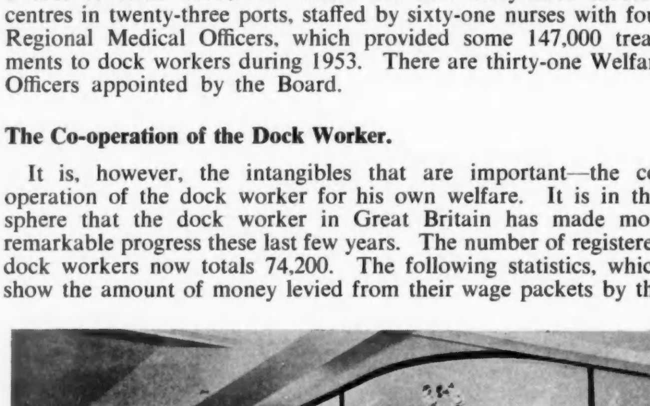
However, the setting up of the Dock Labour Scheme in July, 1947, created the machinery for welfare. There was now, in every port, a recognisable labour force of registered dock workers; there was a National Board of employers and men covering some eighty ports in Great Britain, able to act on behalf of the industry as a whole; it became possible for the first time in the history of dockland to plan welfare as a long-term policy.

In 1952 the National Dock Labour Board issued a pamphlet entitled "Welfare among Dock Workers 1947-1951," designed to narrate factually for dock workers what had happened in welfare since the setting up of the Scheme. Developments during 1952 and 1953 have been so extensive and so varied that that document is now out of date.

Welfare cannot be measured; it is largely intangible; it is an activity of the human spirit. Nevertheless, there are some tangibles which, although of only limited significance, at least indicate the direction of progress. For example, from 1947 to 1952 the Board has spent more than £500,000 on call stands and offices of modern design. It has built thirty-two medical centres in twenty ports at a cost of some £133,000. There are now forty-three medical centres in twenty-three ports, staffed by sixty-one nurses with four Regional Medical Officers, which provided some 147,000 treatments to dock workers during 1953. There are thirty-one Welfare Officers appointed by the Board.

The Co-operation of the Dock Worker.

It is, however, the intangibles that are important—the co-operation of the dock worker for his own welfare. It is in this sphere that the dock worker in Great Britain has made most remarkable progress these last few years. The number of registered dock workers now totals 74,200. The following statistics, which show the amount of money levied from their wage packets by the



There are now 25 Dock Workers' Clubs purchased by the men with money loaned, interest free, by the National Board. These clubs are community centres for Education, First Aid and other activities. This is a view of the Club at Grimsby.

A corner of the Library in the shelter at Bristol. The city Council loans books to the library which are exchanged at three monthly intervals.

men and administered through their own committees, provide a measure of the extent of this active interest:

Association.	1953 No. of Ports.	No. of Registered Dock Workers.	Amount raised by men.
Benevolent Funds	34	37,330	£77,197
Sporting and Social Funds ...	35	34,006	£21,137

During 1953, 283 dock workers paid £1 each to attend Regional Residential Schools organised by the National Board in conjunction with the Universities; 109 men attended a National School at St. John's College, Oxford, in August, and there was a long list of men who wished to attend but for whom there was no accommodation. In addition, 113 men attended Port Workers' Education Classes dealing with dock matters; others attended courses of lectures and discussions, arranged locally with the Universities on related subjects such as Economics and Industrial History. There are three dock workers now completing residential courses at Universities, with supplementary grants from the Board. The men are now setting up, in conjunction with the Board, their own Education Committees to plan and organise the development of this work. Similarly, they are setting up local Ambulance Branches governed by the men who are first-aiders, to promote training in First Aid; there are at the moment thirty-six First Aid classes in operation.

The Dock Workers' Clubs.

In twenty-two ports the men have formed Dock Workers' Clubs as community centres and headquarters for their welfare activities. Each club has its own premises, purchased by the men with monies loaned, interest free, by the Board. The shape, size and location of the premises vary from the small converted "pub" in Great Yarmouth, or a long room over garages in Plymouth, to the "Willows" at Hull, which consists of a large, semi-detached house standing in four-and-a-half acres of ground. In Cardiff the club premises are in the centre of what remains of dockland; in Dundee, it is a fine Scottish mansion, previously a doctor's house, standing high above the harbour with magnificent views over the Tay.

The men have borrowed some £100,000 to purchase these Clubs, of which £10,000 has been repaid and there has been no default in this matter. The Clubs belong to the men. Most have a bar; they are all open to dockers from other ports when they are on transfer or on holiday. Committee meetings, film shows, boxing, skittles, first-aid classes, lectures, flower shows—indeed, nearly every possible welfare activity—will be found in one or the other of the Clubs. The standard the committees set for themselves is to make the Club a place "fit to take the missus into"—and that is a high

Welfare among British Dock Workers—continued

Dockers' Rest Room built at Avonmouth (Bristol) by the British Dock Labour Board. Many such have been built in the last seven years.

standard in dockland. They are family centres. One Club owns its own roundabout for the children, which is used at the annual garden party. They entertain literally thousands of dockers' children at Christmas parties and on summer outings. It is now common practice to give an annual dinner and smoking concert to the retired dockers at Christmas time.

Sports and Other Activities.

The dockers' interests are most comprehensive. Sports include angling, rowing, rugby and association football, cricket, rifle shooting, and archery. The Board's national competitions for dockers are gaining in importance: eighty-four teams are now competing for the National (MacPhillamy) Darts Trophy; seventy-four crews from twelve ports competed in the National Regatta on the Thames in June last; forty-two teams have entered for the National (Newlands) Football Trophy. Last years the winners of this trophy played a team of dock workers in Antwerp and subsequently in London.

In London, the Clubs are forming a Federation to administer their own sports ground of 18½ acres. In Liverpool, the men have bought 11¾ acres, which they have made into a sports ground. They have already spent £20,000 on development and estimate the final cost at some £40,000. This ground was opened by the Duke of Edinburgh in May, 1953. On arrival, he was received on the ground by the committee of dock workers, after which he proceeded to greet civic dignitaries and representatives of the industry.

In five areas printed bulletins are issued dealing with the men's local welfare activities; the cost is borne by the Board; editing is sometimes done by the Welfare Officer, though the articles and notes are generally provided by the men.

Thus from the exploratory field work of the Board's officers has emerged a welfare movement which now embraces a considerable proportion of the dock labour force. Throughout, the Welfare Officers have been activating agents rather than organisers. The National Board, for its part has supported, financially and with technical advice, the efforts of the men in the belief that this will promote respect and responsibility for the well being of the dock worker and the industry. By development grants it has encouraged new and experimental activities which the men wished to try; it has supported their sports by grants related in amount to the monies raised by the men locally, calculated on a formula which is known to them; it has helped the man interested in education by paying part or all of his fees according to the type of course of study; it has paid all the costs of first-aid training; it has loaned money, interest free, to recognised and approved dock workers' clubs and associations whose aims and objects are directed to welfare.

The British National Dock Labour Board has sought to encourage a policy rather than a programme; to co-operate fully with the unions in their welfare activities and to provide—itself—such amenities as are properly its function. But, in the last resort, the responsibility for welfare rests with the individual docker. The National Board is indeed encouraged by the growing measure of willing, voluntary co-operation of all in the industry—employers, unions and men—in this high endeavour.

Improvement Scheme at King's Lynn

The fact that due attention to some of the smaller ports under the control of the British Transport Commission is not being overlooked is demonstrated by the recently completed improvement scheme at the Alexandra Dock, King's Lynn. This scheme, which will facilitate the turn-round of shipping, involved the partial reconstruction of Berths 7 and 8, which now form a modernised quay, 400-ft. long and 32-ft. wide. To minimise interference with traffic operations the work was carried out in three stages.

The first stage consisted of the reconstruction of the quay surface between the Princess Margaret two-storied transit shed and the quay projection on which the cranes operate. This new quay surface is 400-ft. long and 32-ft. wide, and is of reinforced concrete. The rail layout includes two lines of new track flush with the quay, and new approach tracks from each end of the quay with two sets of cross-overs. This part of the work was carried out in conjunction with the construction of new reinforced concrete abutments and a new coping to the original dock wall and supports for the quay projection. An entirely new drainage system for the whole of the quay and a reinforced concrete culvert to accommodate service mains were also provided.

The second stage comprised the mechanical, structural and electrical overhaul of the four 3-ton electric travelling luffing jib cranes serving the quay and the transit shed. For night working, a flood lighting system, which illuminates the entire quay, was installed on the roof of the transit shed, and spot lights were fixed to the jibs of the cranes.

During the third stage, extensive repairs were carried out to the concrete quay projection for the cranes. This projection is 330-ft. long by 29-ft. wide. Specialist contractors were employed for this part of the work, which involved first stripping the surface of the piles, beams and underside of the deck slab between the back of the projection and the quay itself, and then cleaning, replacing and reinforcing it with new concrete, applied by pressure guns. The thickness of the original concrete surface was increased on an average from 2-in. to 3-in.

The newly reconstructed Princess Margaret Quay, Alexandra Dock, King's Lynn.

Shipbuilding Dock at Newport (Mon.)

Details of Method of Construction

By K. C. BURDEN, B.Sc., A.M.I.C.E.

A dry dock of somewhat novel construction has recently been completed for the Atlantic Shipbuilding Co., Ltd., on the west bank of the River Usk at Newport. It has been built for the construction of small ships and is the first phase of a large programme involving larger and similar docks in which vessels of 40,000 tons can be built. The dock which has just been finished is intended for the construction of ships up to 5,000 tons and is 350-ft. long x 60-ft. wide. The floor and sill are at a level which will give 8-ft. of water over the sill several times per month on the spring tides. With 3-ft. 6-in. keel and bilge blocks, the same tide will float a ship up to 7-ft. draught.

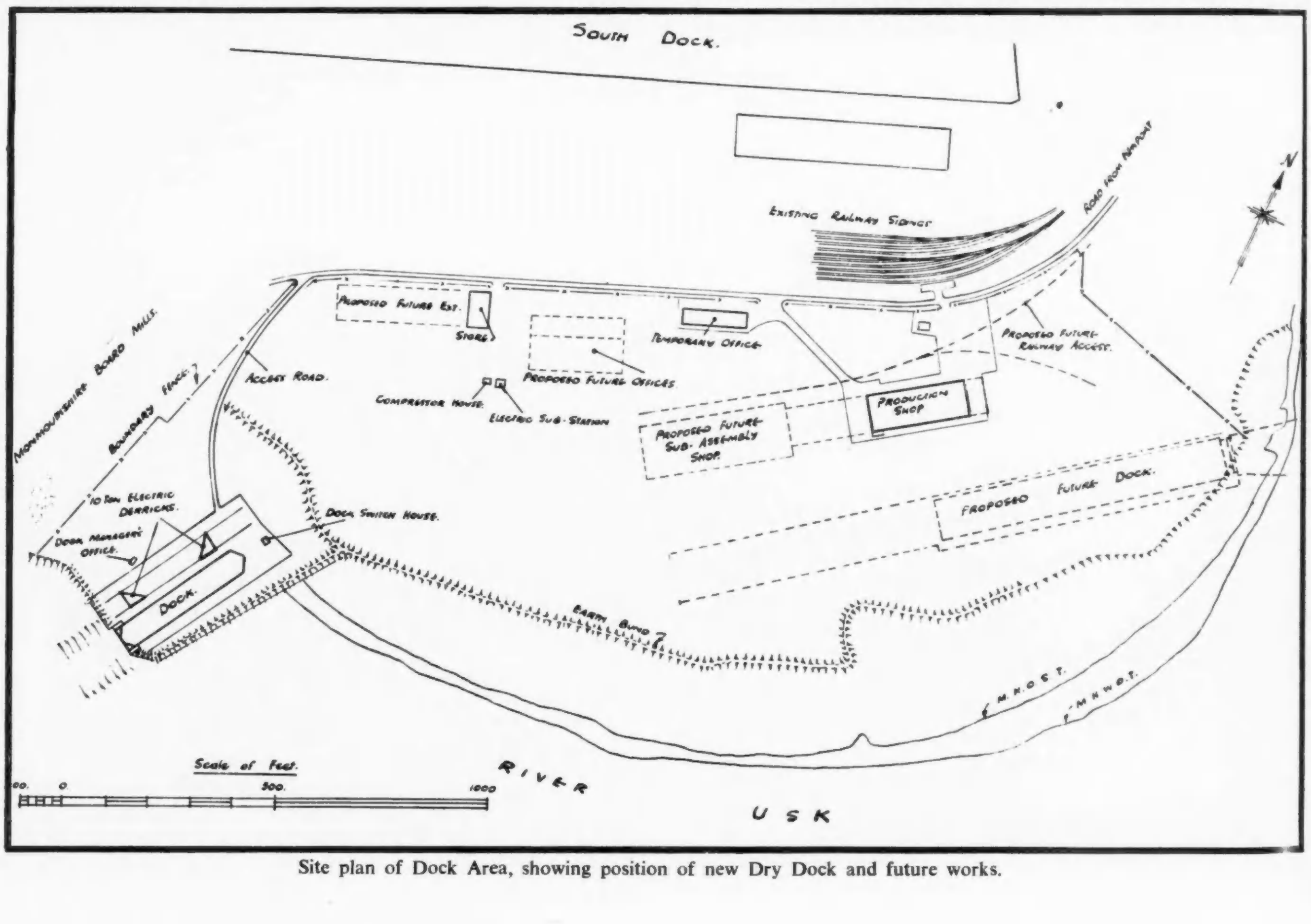
The ships are to be of all welded construction and sections weighing up to 20 tons are prefabricated in an adjacent production shop and are brought to the dock on specially designed trailers, whence they are lifted by derricks and placed in the dock for assembly. The finished hull will be floated out of the dock on a suitable tide and towed to a berth in the Alexandra Dock for fitting out.

The tidal range at Newport is about 40-ft., so that the floor is usually above water level and the river only comes above sill level at high water during the spring tides. The maximum height of the tide above the sill is 16-ft. The general level of the ground in the area of the Alexandra Dock is 79-ft. above dock datum, but for economy in the construction of the dock walls and filling, which had to be imported, the cope level of the dock has been made 76.5, which is 6 inches above maximum tide level. The top of the gate and buttresses, the wing walls and the bund surrounding the dock area, have all been built to level 79 to conform with the general level of the Alexandra Dock area and to protect the working area against wave action.

The Atlantic Shipbuilding Company's yard is situated between the river and the Alexandra Dock. The new dock has been sited at the southernmost end of the yard and has been aligned diagonally to the main channel of the river. The site chosen was on the saltings, which are normally above water level but covered by spring tides, and the head of the dock lies in what was thought to have been an old river entrance, disused since the diversion of the river by the construction of the Alexandra Dock and now known as "Pilots Pill". At the northern end of the site is the first part of the production shop. In siting the dock and shop, full attention was given to the ultimate layout of the yard, and space has been left for the extension of the production shop, sub-assembly shops and two or more large building docks. Since the latter will be of more importance than the small dock already constructed, the best sites were reserved for them, and the small dock is sited to fit in with the final layout.

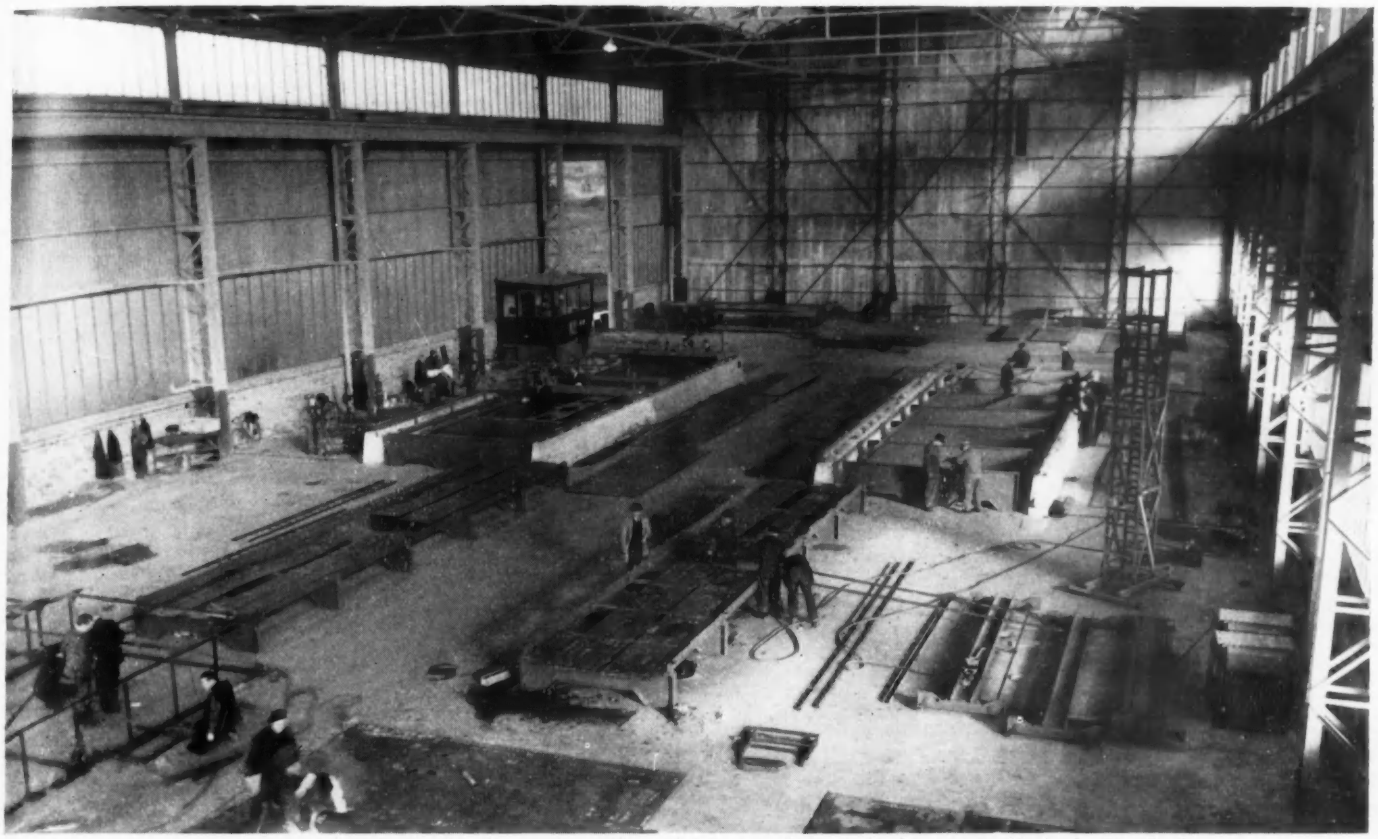
The dock was constructed in ground consisting of silt and soft clay to a depth of 40-ft., where there is a stratum of sandy gravel of varying thickness, below which there is clay until marl is reached about 70-ft. below ground. The dock was constructed with steel sheet pile walls and reinforced concrete floor, the toes of the sheet piles being held by the floor, and the tops tied back by steel anchor rods to anchor walls. The structure was stabilized by driving king piles at 5-ft. intervals along the perimeter of the dock down to the sandy gravel stratum and bonding these to the sheet pile walls.

The front of the dock is protected by No. 3 section sheet piles driven down to the gravel stratum. These piles were driven with their tops at level 79 and subsequently cut off at sill level after the gate was in position. The gate buttresses are constructed of 30-ft. x 10-ft. sheet pile coffer-dams, inside which piles were driven to the sandy stratum and surmounted by a reinforced concrete raft. On the east buttress the sandy stratum was found to be somewhat thin, and some of the piles were driven to the marl. The upper part of the buttresses is mass concrete and a pump chamber is housed in the western buttress. The sill was constructed of reinforced concrete and carried on piles. The dock floor is 18-in. thick con-

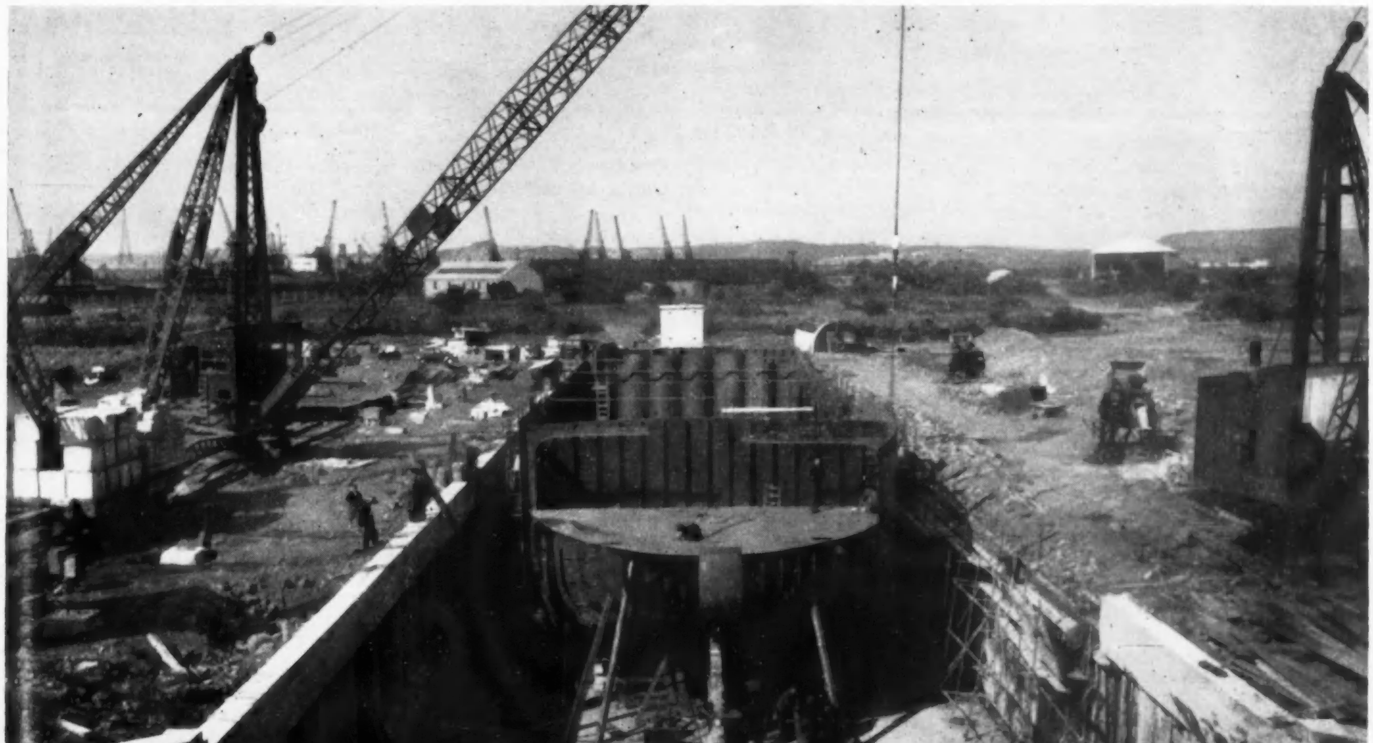


Site plan of Dock Area, showing position of new Dry Dock and future works.

Shipbuilding Dock at Newport (Mon.)—continued

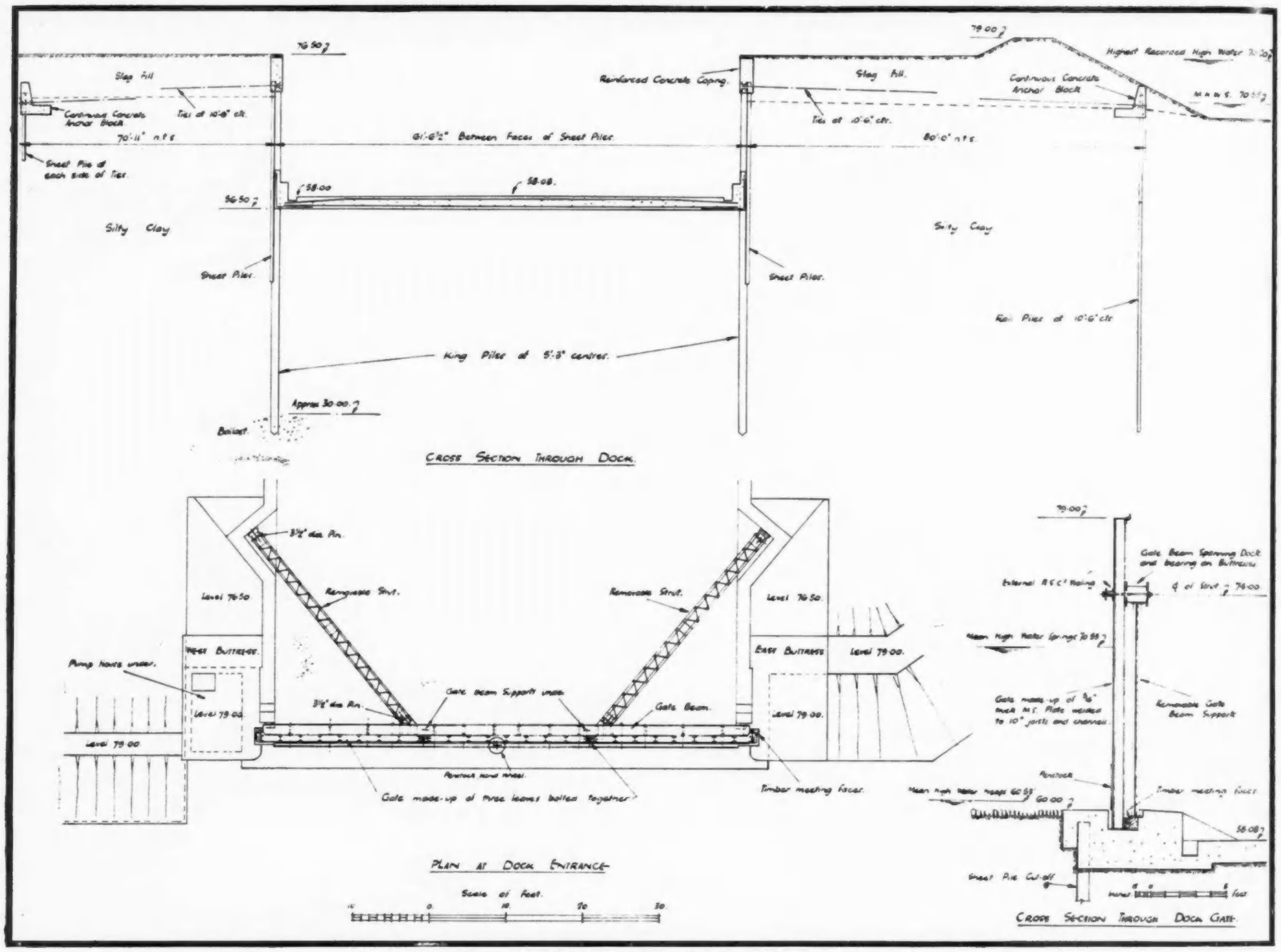


A part of the spacious Production Shop, where ship sections are prefabricated prior to assembly in the Dry Dock.



Hull of 3,000 ton ship nearing completion in Dry Dock. Note work is proceeding simultaneously on the ship and on completing the coping of the dock.

Shipbuilding Dock at Newport (Mon.)—continued



Some details of the Dry Dock and Gate.

crete, reinforced with steel rails and Isteg bars. A 3-ft. high haunching was provided at the sides.

The design of the gate is somewhat novel, being particularly adapted to the circumstances. As has been previously stated, the sill is more often than not above water, so that the gate could be removed or placed in position in the dry. It is estimated that the construction of a ship will normally take three months; therefore, the operation of removing and replacing the gate is to be done only four times per year. The construction of the ship is carried out by 10-ton derricks and it was decided, therefore, to make a steel gate which can be lifted out by one of the derricks in sections each weighing less than 10 tons. The gate was accordingly constructed in three panels, each approximately 22-ft. wide, made up of welded plate and joist construction. These panels span vertically between the sill and a beam lying across the dock just below high water level. This beam is supported at its ends by the buttresses and at two intermediate points by diagonal struts to the rear of the buttresses. The struts are fitted with $3\frac{1}{2}$-in. dia. pins which can be withdrawn easily. The meeting faces between the panels are of greenheart timber with a rubber insert, and bolts are provided for tightening the panels together. Timber meeting faces between the gate and the concrete sill are also provided.

A concrete coping was cast to the tops of the sheet pile walls and water, electricity and compressed air services have been laid down both sides of the dock adjacent to the coping. Rubble drains run below the coping for the full length of the dock and discharge through tidal flap valves into the river. On the west side of the dock, two 10-ton derricks with 120-ft. jibs travelling on rail tracks have been installed.

The ground to the west and north of the dock has been filled and levelled, thus reclaiming a considerable area of the salting for use as a working yard.

Auxiliary buildings for ship construction, including a production shop, an office block, stores building, oxygen house for piped gas supply, electrical sub-station, switch house, compressor house and dock manager's office, together with connecting roads and hard-standings for the storage of materials have also been constructed. The production shop is 85-ft. clear width x 240-ft. long, with a 10-ton overhead travelling crane giving 25-ft. clear headroom. The end nearest the dock is open, whilst the northern end is enclosed temporarily with sheeting carried on a tubular scaffolding framework, it being intended to extend this shop in both directions. The construction is orthodox steelwork with asbestos cement cladding, and the stanchions are carried on in-situ reinforced concrete piles driven to the sandy gravel stratum.

The work was started in July, 1953; the Production Shop was finished in October, 1953, and the dock in May, 1954. Such was the urgency of the project that the pre-fabrication of the first ship to be built in the dock was commenced in the Production Shop in November within a few days of the completion of the building, and the first section of keel laid in January, 1954, whilst the dock was still under construction. Building of the ship closely followed the concreting of the dock floor and the ship was ready for floating out in July, only a few weeks after the completion of the entrance works to the dock.

The Contractors were John Howard & Co., Ltd., London. The author is indebted to the Hon. Sir Ralph Cochrane, G.B.E., K.C.B., Managing Director of the Atlantic Shipbuilding Co., for permission to publish these details.

Aluminium Crane Jibs

The jetty at Purfleet, operated by Wm. Cory & Son, Ltd., is equipped with five 7½-ton grabbing cranes, which are used principally for unloading coal, sugar, sulphur, etc., from cargo vessels into river barges. Originally it was planned to equip all these cranes with 80-ft. steel jibs; the radius of these jibs, however, was found insufficient to span some of the larger ships now being handled at the jetty to permit unloading into barges over the offshore side of the ships. It was necessary therefore to increase the length of two of the jibs to 90-ft. To have used steel jibs of this length would have entailed considerably increased weight in the cranes, which in turn would have called for heavy reinforcement of the existing jetty, at very considerable cost.

After considering the various means of lightening the jibs, aluminium construction was chosen, resulting in a reduction in weight over the steel jibs by some 60%, despite an increase in reach of 10-ft. The weight of each 90-ft. aluminium jib is 2 tons 11½ cwt. compared with the 6 tons 13 cwts. of its 80-ft. steel counterparts.

Photograph showing the greater length of the two aluminium jibs.

The aluminium jibs were designed to withstand a 100 per cent. overload with a factor of safety of 4 in compression and 4.5 in tension, these factors being somewhat reduced for the effects of wind loading.

Since the high-strength alloy HE 15 WP, used for the main booms, does not possess as high a resistance to industrial and marine atmospheres as does the more normal structure alloy HE 10 WP, it was decided to spray the jibs with a 0.006 inch thick coating of pure aluminium. They are unpainted.

The first of the aluminium jibs was erected in September 1953 and the second in November 1953. They were fully fabricated in the S.M.D. works at Slough, and transported by road to the Albert Docks and thence by barge to Purfleet. Both were subjected to very exhaustive acceptance trials and proved completely satisfactory; since then they have been in continuous use and the average monthly tonnage discharge by each crane has been 11,000 tons.

These aluminium jibs were designed and fabricated by S. M. D. Engineers, Ltd., in co-operation with Mr. G. T. Shoosmith, M.A., M.I.C.E., M.I.Mech.E., M.I.Mar.E., at that time Chief Engineer to Wm. Cory & Son, Ltd., and with Clyde Crane and Engineering Co., Ltd., the main contractors.

World's Largest Dredger.

What is claimed to be the world's largest self-propelled cutter-suction dredger is being built for Dutch contractors. The vessel has been specially designed for service in tropical waters, and is 70 metres in length and 11 metres beam. It will be fitted with diesel-electric machinery, power being supplied by three generators driven by M.A.N. diesel engines; the suction pipe will have a diameter of 75 millimetres and sludge will be delivered through a floating pipeline up to 8 kilometres distance.

Obituary

Mr. W. C. Gravely

We regret to have to announce the death on the 26th July last of Mr. William Cecil Gravely, a former Associate Member of the Institution of Civil Engineers, who had a wide experience in dock and harbour engineering.

Mr. Gravely was born on the 3rd July, 1874, and received his technical education at the Crystal Palace School of Engineering, where he obtained the Bronze medal. For a number of years, he served as Resident Engineer on important harbour works in the Isle of Man, and with J. Watt Sandeman, M.I.C.E., on jetties and harbour works in North-East Coast ports. In 1915 he was appointed Assistant Engineer on the staff of the Tyne Improvement Commission, and two years later became Resident Engineer at the Commissioners' Albert Edward and Northumberland Docks. In 1934 he was appointed Senior Assistant Engineer in the Chief Engineer's Office, becoming Chief Assistant Engineer after two years, which position he retained until his retirement in 1939.

During the war years, Mr. Gravely was recalled to take over the position of Resident Engineer at the Commissioners' Piers Works, South Shields. He finally retired in 1945.

Mr. Gravely was responsible, under the late Mr. R. F. Hindmarsh, who was then Chief Engineer to the Commissioners, for many important works, including the design and construction of the Tyne Commission and Oslo Quays, and Howdon and Jarrow Staiths.

New Factory for Southampton Docks

The industrial potential of Southampton is shortly to be increased by the erection of a factory at the New Docks by Standard Telephones and Cables Limited, which will be equipped with the latest machinery and facilities for the production of submarine telephone cable and submerged repeaters and which will be the equal of any factory of this type in the world. The initial project will cover ten acres of land at the extreme west end of the New Docks in the area between West Bay Road and Herbert Walker Avenue and the complete scheme will take in a further adjacent eight acres.

The selection of Southampton Docks for this important branch of the electrical engineering industry was made because of the good rail and sea access, both of which are important in the manufacture and shipment of this type of equipment to world markets.

In order to lay cables and repeaters on the sea bed cable ships are employed and the cable is fed straight from the factory into the specially designed holds of the cable ship. The British Post Office Cable Ship "Monarch," the largest cable ship afloat, having a gross tonnage of 8,056, can carry between 5,000 and 6,000 tons of cable. The proposed site at Southampton is therefore ideally suited to this purpose, with good docking facilities and ready access to deep water and the world's sea routes.

Submarine cables and repeaters are complementary to radio links for the passage of speech across wide river estuaries, seas and oceans, but whereas conversations by radio may be subjected to fading and interference, they may be passed over a short submarine cable without any effective loss of quality. However, if the cable is very long the received speech might be weak and unintelligible due to electrical losses, and it is, therefore, necessary to insert repeaters at regular intervals. These devices are valve amplifiers which boost the signals so that a satisfactory volume of speech is given at the far end of the cable.

The cable and repeater units have to be very strong, corrosion-proof and completely watertight, to withstand lying on the sea bed in deep water where pressures from five tons per square inch may be encountered. The valves and other electrical components in the repeater units must operate without fault or failure for periods of many years, and arrangements have to be made to pass electrical power along the length of the cable to feed the valve circuits.

The new factory will be capable of producing submarine telephone cables and repeaters to span the oceans of the world.

Manufacturers' Announcements

Handling and Stacking of Paper Reels

A new reel clamp attachment, for use in economical handling and stacking of paper reels, was recently demonstrated by a battery electric fork truck at the Wembley depot of the Conveyancer Fork Truck Company. The attachment can be fitted to any of the electric and torque-converter oil or petrol driven models in the firm's range of fork trucks. It was effectively shown in the demonstration that the reel clamp provides a means of quicker, easier and space-saving storing of reels, which can be stacked vertically by this process.

The operation of the conveyancer reel clamp attachment, which can be fitted to the standard carriage, and is inter-changeable, is hydraulic. The amount of vertical movement depends upon the size of mast (9-ft., 12-ft. or 14-ft.), which is fitted to the truck, and at the demonstration two reels, each measuring 4-ft. in length by 2-ft. diameter, were carried and stacked on a third reel. The model used could lift 2,000 lb. with a 9-ft. mast, and reels may vary in size between 24 and 42-ins. in diameter.

Several conveyancer torque-converter trucks are in service in the South West India Dock at the Port of London, and a squeeze-clamp attachment truck, originally designed for the Raw Cotton Commission, is also in use there.

Pallets suitable for fork lift and crane use are also produced by this company. These include a standard steel model, originally designed for the Ministry of Supply, measuring 54-ins. by 48-ins., and other containers suitable for a variety of industrial uses.

Repairing Concrete Floors

The Ruberoid Company claim to have solved the problem of potholes and cracking in the floors of factories and warehouses caused by the movement of heavy loads. The inconvenience and heavy cost of relaying the whole floor area can be avoided by the use of a floor mix which gives better results at less cost than anything evolved before. It is easy to prepare, simple to apply and very durable. The mix consists of 1 part cement, 2 parts sand and 1½ parts Ruberoid Plastic Compound No. 100.

The chief characteristic of the specification is the manner in which the floor mix keys to shallow potholes—no cutting out of the concrete is required. The mix is simply trowelled on the cleaned and primed concrete. Cracked floors are treated in the same way.

Ruberoid Plastic Compound No. 100 is an emulsified bitumen compound, and its inclusion in the specification ensures durability and allows for a margin of flexibility.

The New Crone & Taylor "Meteor" Thrower

An increasing number of commodities is being carried in ship in bulk and more and more general cargo vessels are being used for the purpose. One thing to be particularly watched, when loading such ships with bulk cargo is that there is no loss of freight space, especially when the commodity being handled is not "free-running." Sugar is a commodity which does not run freely and consequently it requires much trimming. Manual trimming being arduous and expensive, mechanical means are being sought.

The new Crone & Taylor "Meteor" thrower serves the purpose in view. The method employed is first to form, on the ceiling of the hold and in the square of the hatch, a bed of the commodity being loaded. On to this is lowered the "Meteor," which will project the material away from the square, into the wings and up to the bulk-heads. Electrically driven, it is mounted on a circular turn-table and, receiving the bulk through a hopper placed at upper deck level (this ensures an even flow into the thrower), it can throw to a height of 20-ft. and over a distance of 50-ft. Each deck can therefore be compactly filled right up to the deck head—and only one man is required to operate the machine.

The "Meteor" is now being used to trim bulk sugar as it is loaded into ship for export from the West Indies. The feed hopper used for this work is covered with a strong grill, thus preventing the clogging of the machine by lumpy sugar. The hopper itself is fed either manually (from bags) or by grab.

The "Meteor" thrower is suitable for handling many other bulk materials than sugar and is useful for other purposes than shiploading. It can, for example, be employed for piling in warehouses and in the open. Its makers claim a capacity of up to 300 tons per hour, with a throw of maximum height of 45-ft. to a distance of 70-ft.

New Lightweight Fire Pump

The Sigmund Rover 1S/60 light-weight 400 g.p.m. fire pump is claimed to be an ideal unit for modern fire protection. It is small in bulk, easy and quick to start, with fast priming and absolute dependability at all times.

By combining the advantages of the latest Rover gas turbine with those of the Sigmund high speed centrifugal pump, the new unit gives advantages not obtainable previously by any equivalent portable petrol driven fire pump. It is mounted in a light weight tubular frame, complete with fuel tank with sufficient capacity for 25 minutes' operation, and a fully instrumented panel, for easy portability, or alternatively for use as a trailer unit.

The pump can be run on diesel, paraffin, or petrol fuel, and has a standard N.F.S. fitting of twin discharge branches. There are grouped starting and priming controls, and instrument control panel.

In addition to fire protection duty on land, the Sigmund Rover 1S/60 is suitable for shipboard service, and can be operated on deck to give prompt and efficient protection in case of fire at sea.

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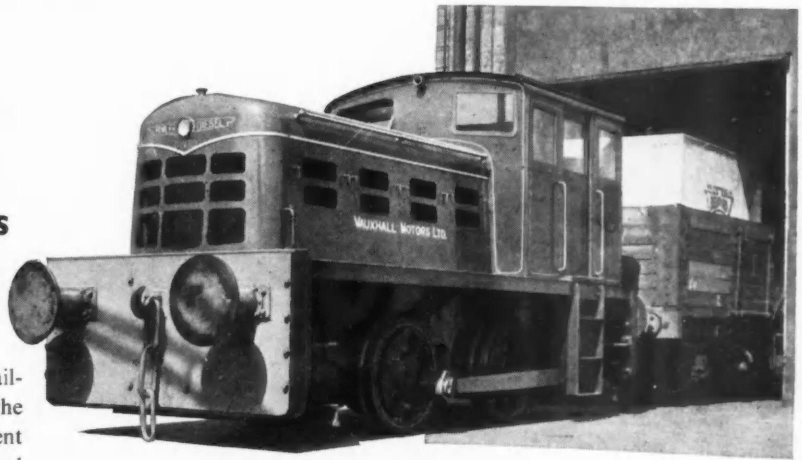

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